

January 7, 1957

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AVIATION WEEK

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PUBLICATION

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A few years ago, this jet pilot would never have lived to tell the story.

Minutes ago he was flying faster than sound itself, cannon-balling 60,000 feet up—through the rarified air of a crisp winter sky.

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Bailing out of a crippled aircraft at that altitude, speed and temperature—a cut-throatly equipped pilot would not stand a chance. The superheated rush of air would rip his protective clothing to shreds exposing him to explosive decompression and sub-zero cold.

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The capsule provides rescuers crew comfort for efficient ejection performance plus a complete automatic escape system for special delivery of aviators in distress.

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130 TRIMPOT[®] solder-lug type



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The silver plated solder lugs are extremely rugged. Instrument is not affected by soldering iron temperatures.

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Round pin terminals on this unit may be plugged into holes in your printed circuit boards for dot soldering. Terminals are gold-plated copper, 1/16" (1.6mm) diameter and spaced at right angles at 0.1". Mounting is accomplished by 256 screws through body apertures, or by pins only.

BOTH UNITS PROVIDE: a stable potentiometer range of 95%, and low resistance resistance either end 0 to 1%. Low temperature coefficient wire is utilized in the precision wirewound resistance elements.

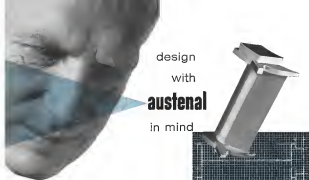
In all other design features, these instruments are similar to the original Model 130 TRIMPOT. Each is solderable in size (0.7" x 0.7" x 0.2") and weighs only 0.1 oz. Other characteristics include 25 turn screwdriver adjustment, self locking shaft, and excellent performance under extreme shock vibration and acceleration. Wide input or output load impedance specifications. Delivery from stock on standard resins. Send for Bulletin 130 and 205.



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General Offices: 6139 Magnolia Ave., Riverside, Calif.
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AVIATION CALENDAR

- (Continued from page 1)
- Feb. 18 (Sat.)—Aerial Trade Show & Convention.** Institute of Aeronautics, New York Trade Show Bldg., New York.
- Feb. 26-28—Western Joint Computer Conference,** sponsored by IBM, NIE, and USC. Hotel Statler, Los Angeles, Calif.
- Mar. 7-9—National Conference on Aeronautics Education.** Hotel Marlborough-Windsor, Los Angeles.
- Mar. 11-15—1957 Aeronautics Exposition including Nuclear Engineering & Science Computer 5th Annual Meeting, in Aeronautics Conference and 10th Inter Laboratories & Component Conference.** Convention Hall, Philadelphia, Pa.
- Mar. 14-16—Pacific Engineers Meeting (Classified)** sponsored by IAS. Hotel Century, Cleveland, Ohio.
- Mar. 18-20—Turbine Power Conference,** sponsored by American Society of Mechanical Engineers. Sheraton-Cadillac Hotel, Detroit, Mich.
- Mar. 18-21—Pacific Coast Flight Progress Report, in connection with The Society for Flight Engineers National Conference.** Sheraton Exposition Hall, Los Angeles.
- Mar. 18-21—National Conference Institute of Radio Engineers.** New York, Columbia and Hotel Waldorf Astoria, New York.
- Mar. 20-21—1956 National Meeting of the American Microscopical Society.** University of Chicago.
- Mar. 21-27—Silver Anniversary Technical Meeting and Convention.** American Society of Test Engineers. Sheraton-Windsor Hotel, Houston, Tex.
- Mar. 21-26—Western Metal Congress and Exposition.** Ambassador Hotel and Fair Pacific, San Francisco, Calif.
- Mar. 21-29—Aeronautical Collection on Radiation Effects on Materials** sponsored by ONR and Glenn L. Martin Co., International Aerospace Education, Vol. 1.
- Apr. 10-17—First Demonstration and New Program in Systems for Organization, Storage and Retrieval of Information,** sponsored by School of Urban Sciences Center for Documentation and Communications Research, Western Reserve University, Cleveland, Ohio.
- Apr. 17-20—1956 Annual Conference of the Society of Aeronautics Engineers.** Hotel New Yorker, New York, N.Y.
- Apr. 24-25—Second National Industrial Research Conference,** sponsored by American Research Foundation, Central Union Hotel, Chicago, Ill.
- May 1—Aerospace Meeting and Exhibit.** Society for Experimental Space Studies, Hotel Statler, Boston, Mass.
- May 6-12—1956 Annual Meeting.** Aero Medical Assoc., Statler Statler Hotel, Denver, Colo.
- May 8-11—1956 Annual National Forum.** American Helicopter Society, Sheraton Park Hotel, Washington, D.C.
- May 24-26—2-2nd Form for New Building of Pacific Aeronautics Convention.** Le Borgne Airport, Paris.
- June 19-21—First Annual National Aeronautics Trade Show.** McCormick County (N.Y.) Airport.
- June 25-27—29th Annual Meeting.** Aviation Distribution & Manufacturers Assn. The Broadview-Columbia Springs, Colo.



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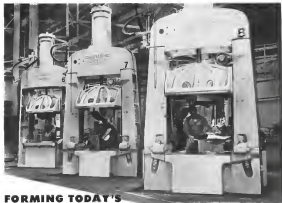
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Send for Bulletin 30-L-5.

GECOSTAMP

CHAMBERSBURG ENGINEERS CO.



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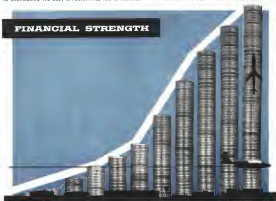
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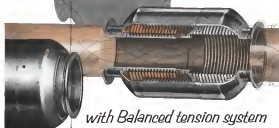


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*Permanent Thermal Duct Thrust is the end force or reaction created by a rapid thermal duct system employing bellows. This duct thrust is caused by the tendency of the bellows to elongate or strengthen and under pneumatic pressure.

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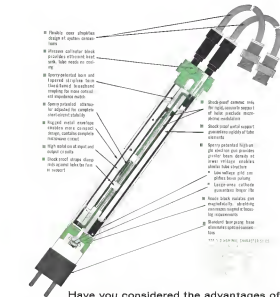
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Have you considered the advantages of Sperry ALL-METAL travelling wave tubes?

The new Sperry all-metal travelling wave tube shown here is customarily made from stainless steel. It is now produced to provide the driving power for multi-megawatt systems used in defense radars. Its characteristics, however, open the door to unlimited new applications. Being made of metal, this Sperry travelling wave tube is rugged—withstanding far greater shock and vibration

than any previous tube. Electrical characteristics are better, providing excellent phase stability. And from the system engineer's standpoint application is simpler. Sperry's all-metal travelling wave tube conforms to your design, eliminating the necessity of designing to conform to the tube. And data sheet on the S78-119 is yours for the asking and our Elec-

tronic Tube Sales Department will gladly give you information relating this new development to your specific project.



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Wright-wing magnesium skin (white area) is used for leading edges, wingtips, wheel doors and many other parts of F8U-1 Corsairs.

25% of external skin on record-breaking F8U-1 made with magnesium

In Chance Vought's F8U-1 Corsair, latest U.S. fighter by official record, many precious pounds are saved by using magnesium. Designers called for a total of 160 magnesium external skin parts—85% of the wing and fuselage surface area. 275 magnesium steel castings ranging in weight from a few ounces to thirteen lbs. were used inside the skin.

Weighing one fourth as much as steel and only two thirds as much as aluminum, magnesium gives you the best combination of strength and rigidity per pound. Its stiffness-to-weight ratio is the highest of any structural metal.

Magnesium permits clean, simplified design—eliminates many struts and detail parts. A solution of fuselage provides remarkable protection against corrosion. Machinability is excellent, too. Fabrication, fitting and joining problems are always at a minimum.

Magnesium can help you make better designs for fuselage, wings and control parts. Sheet, extrusions, and castings can be easily produced to meet your requirements. Call your local Dow sales office, or write to THE NEW CHEMICAL COMPANY, Willard, Michigan, Department M1263G-3.

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EDITORIAL

Industry Faces Knotty Problems

This will be another good year for the air transport and aircraft manufacturing industries. Aircraft manufacturing sales should be close to \$9 billion, while airline revenues will continue well over the billion dollar mark.

However, in the midst of the current prospects, both the airline and aircraft manufacturing industries face knotty problems that must be solved soon if their futures are to continue to be bright with the same new hue that has characterized the past few years. The effect of these problems will not be seriously felt for another two or three years.

But, by then, it will have become too late to effectively solve them.

The foundations for sound solutions to these problems must be laid now, and the legislative battles must be fought and won during the session of Congress that has just begun. Otherwise, the lead time required to set in motion the necessary action to dissolve these problems will be lost, and the problems will face both the airlines and the manufacturers in the acute form of crisis.

To build and solve these problems, aviation will need effective and persistent action from its two prototype trade groups, the Air Transport Association and the Aircraft Industries Assn., the cooperation of legislators adequately informed on aviation affairs and most important of all, a sympathetic public understanding. This is admittedly a big order, but the stakes involved are also large. Both the airline and aircraft-making industries have a continuing role to play with the federal government which regulates the industry and is the major customer of the manufacturers.

The aviation industry is now faced with a clear set of alternatives for its future. It can either stand up and fight for its rights and exploit its responsibility as an integral part of the modern American profit-oriented economic system or it can quietly whimper and grope in the background and gradually see the fundamentals of its position dissolved by the end of increased and unmanaging government control.

Industry Problems

Among the major problems facing the aircraft manufacturers are:

• **Adequacy of safety exposure.** This goes far beyond the self interest of the aircraft industry; it has genuine responsibility to see that our safety exposure is adequate, first because as the best informed bearing witness of this country on the subject, its members have a more accurate vantage to measure this adequacy, and, second, because if the inadequacy of the force on which this country now relies for protection becomes publicly apparent, it is the aircraft industry that will be looked to as the first respondent.

• **Profit limitation.** Nobody questions the accuracy of some form of profit limitation legislation, but there are serious doubts as to whether any of the present legislation on the books, including the latest version of the Reconstruction Act and the Wilson Tariff Act, meet

the requirements of the modern industry/airline relationship. A financially sound and administratively efficient method of profit limitation legislation is vitally necessary for the aircraft industry to fulfill its technical responsibilities for the future, particularly in meeting effectively its research and development facilities and programs.

• **Weapon system management.** This new military management philosophy portends many changes in internal organization and external customer relations for the aircraft industry. Still in a formative stage, this philosophy requires an intelligent and responsible watchdog position from all segments of the industry to keep it from becoming a bureaucratic nightmare.

• **Technical manpower.** Demand for technical manpower in the aircraft industry will increase and become an increasingly limiting factor on the gross effort toward technical progress. Industry must ensure leadership in pushing for both internal and external policies that will provide adequate technical manpower for the future.

Problems for the Airlines

Looking ahead to the airline future we see the following major problems:

• **Passenger service.** There is no better way to build public confidence in the airlines than by providing superb passenger service from the moment jobs Public applies for a reservation until the time he is delivered safely and reasonably on time at his destination. There is no quicker way to lose public support than by letting the passengers around like a freight shipment. Airlines will have to devote all the effort possible within the limits of their resources to a continuing attack on this problem if they are to grow economically and enjoy the public support so richly needed in their legislative battles.

• **Air traffic control.** This program will again bog down in the maze of intergovernmental maneuvering unless it gets vigorous support from the air transport industry. Without a semi-autonomous air traffic control system capable of handling with increased traffic with current or better weather minimums, the airline industry cannot hope to expand adequately.

• **New facilities.** The enormous post war growth of passenger volume and the technical evolution facing the airlines will see the present airports as maximum capacity met for new ground facilities ranging all the way from runways to surface transport to and from terminal areas. These facilities won't be needed without strong and steady pressure and intelligent cooperation from the airlines.

These are knotty problems that cannot be solved in a single battle. They must be the subject of persistent, intelligent and vigorous industry action. Both the aircraft manufacturing industry and the airlines are too vital a part of the modern American economy to escape non-trust public scrutiny and to hide their heads outside like the snail.

—Robert Dietz

Fenwal Introduces—

NEW, SMALL, LIGHT DIFFERENTIAL THERMOSTAT

Fenwal Solves Camera Compartment Problem, Comes Up With Control With Broad Applications

ASTLAND, MASS. — An aviation company is the habit of taking its temperature control problems to Fenwal solved Fenwal experts here how to control the temperature in a new glass's camera compartment.

Fenwal's experts solved the problem quickly, and are making an exact of their Titer solution, a broad-range differential thermostat control, will find a thousand other applications — in the aviation industry and out.

The device, weighing only 0.3 of a pound, consists of two midsize Fenwal transducers[®] with a relay — permanently sealed in an integral stainless steel housing.

Camera Compartment Control

When it made its debut, the unit had only one purpose — to keep a camera compartment warmer than 90°F and cooler than 155°F. It called for heat at the lower limit, and shut off heat at the upper one. It also measured the wear life and the life of the mechanism controlled by eliminating about ten cycles, by signaling for residual action only at either limit of the acceptable temperature range.

Wide Applications

Actually, this control, which isn't much bigger than a 50 miller valve, can control, in a dozen's dozen, because it can be used to signal for any sort of action when an upper or lower temperature limit is reached. It can be factory set for limits anywhere from —50°F. to +400°F.

The relay rating at 28 volts D.C. is 5 amps maximum, 1 amp inductive, and 5 amps overhead. Due to high altitude performance requirements, the unit has positive a three-terminal heater and sensor.



In the course of its development, the unit came by a name that doesn't begin to describe its versatility — the Fenwal Camera Compartment Over-Heat Control. As happens again and again at Fenwal, experts here started with a specific problem, and found that they had thereby invented the Fenwal Product here generally, with a widely useful concept of temperature control.

Contact your local Fenwal sales engineer, or write to Fenwal direct to

learn how this and other Fenwal developments may solve temperature control problems now facing you. Fenwal Incorporated, Aviation Products Division, 121 Pleasant Street, Astland, Massachusetts.

Fenwal
CONTROLS TEMPERATURE
...PRECISELY

WHO'S WHERE

In the Front Office

D. G. Wood, vice president-engineering, Lockheed Aircraft Support, Inc., Ontario, Calif.

Gay, Benjamin W. Chadler (USAF, ret.) chairman planning committee, Thiessen Products Inc., Cleveland, Ohio. Gay Chadler is a vice president and director of the company.

Levinson, Deloris, Aero Manufacturing Corp., Stratford, Conn. has increased the appointment of three personnel assistants. Turner, A. Thomas, chief nuclear systems, Atlas, Edward L. Woodwell (USN, ret.) administration. Paul A. Douglas, public relations and advertising.

James D. McLean, president and general manager, Hoffman Laboratories Inc., Los Angeles, Calif. Mr. McLean succeeds John R. Moss, now chairman-executive committee.

Lee S. Johnson, general manager, Atlas Aircraft Division, United Aircraft Corp., East Hartford, Conn. Mr. Johnson succeeds Bernard L. White, who continues as a vice president and member of the operating and policy committee.

Honors and Elections

Anthony Kolb, manager Aviation Sales Division of the Evans Company, Inc., has been elected 1967 chairman of the Aviation Technical Service Committee, Division of Materials, American Petroleum Institute, New York. W. D. Polak, assistant vice manager of Phillips Petroleum Co. succeeds Mr. Kolb as chairman of ATSC's Subsector on Jet Fueling Systems.

Changes

John F. Pelt, director of engineering, The Pacific Co., Redding, Conn. Bernard Depierre appointed a consultant to Boeing Aircraft Co.'s Transport Division. Mr. Depierre's office is in Paris.

John F. Hinkins, administrative manager, Research Division, Fiat Aircraft Corp., Buffalo, N. Y. Also Robert E. Hinkel, senior manager. William Shultz, sales area supervisor, Ronald E. Shultz, control plane division manager.

Paul Goldschlager, Staff Director for Commercials, Office of the Assistant Secretary of Defense Supply and Logistics, Washington, D. C.

Walter K. Galtman, manager personnel and training sales Aviation Products Division, B. F. Goodrich Co., Akron, Ohio. Louis F. Edelman, chief inspector, Natick, Mass. Mr. Edelman's office is in Natick.

William D. Socher, assistant general manager and director of engineering, Avco Inc., Woodbridge, N. Y. Moving A. J. McCarthy, Jr. becomes an assistant manager and Frank DeWahl succeeds Mr. McCarthy as general manager. Avco's Aviation Products Division, B. F. Goodrich Co., Akron, Ohio.

Donald M. McGuffee, chief manager, Sales Division, Avco Aero Corp., Avco Inc., Woodbridge, N. Y. Moving A. J. McCarthy, Jr. becomes an assistant manager and Frank DeWahl succeeds Mr. McCarthy as general manager. Avco's Aviation Products Division, B. F. Goodrich Co., Akron, Ohio.

(Continued on page 121)

INDUSTRY OBSERVER

► Douglas Sparrow 2, an active-holding air-to-air missile developed to a different requirement than the Sperry Sparrow 1 and the Sparrow 2, differs in external configuration from the point-to-point, delta-wing Sparrow 1. Nose of Sparrow 2 is blunted to match the housing delta wing, fins and wings have been changed at the tips so that they are now impervious to air rather than transverse. Sparrow 2 has been chosen by the Royal Canadian Air Force to replace the Canadian-developed Vexel Glava as missile element for the Avro CF-100 (AW May 5, p. 21).

► Air Research and Development Command's Western Development Division is making five proposals as a design study contract for an environmental laboratory system. The contract would provide an alternate to one already being conducted by Hughes & Norris, Inc., a Los Angeles engineering firm. Contract would include provision for housing sites, barracks and railroad sidings.

► Tracker guidance system for Navy's second missile carrier, the USS Canberra, is the Sperry SPQ-5. The SPQ-5 differs in detail from the Keres instrument system and about the earlier USS Boston. It has the same accuracy to modify the missiles to match the Sperry system.

► Lockheed F-104H, tandem-seat version of the Straightjet, was scheduled to make its first flight last week. The XF-104, experimental version of the F-104, has completed 900 flights and logged more than 510 hr since its initial flight in February 1954.

► Grumman Aircraft is building an early warning version of the Navy's SRF-1 Tracker with the designation WF-3. A large cut missile, similar to the 10-ft experimental model on Navy's WV-2 Super Constellation (AW Aug. 15, p. 27), is mounted above the Tracker fuselage.

► Leda's latest experimental supersonic target interceptor, the Q-12, has begun its flight test program at the French air force test base at Istres. Q-12 can make regular takeoff rather than being carried aloft in a mother ship as was predecessor, the Q-11.

► Douglas Aircraft Co. has received a \$10,835,315 contract from the Air Materiel Command for Iran and modification of C-124 transport aircraft.

► Hercules Page Ltd. now offer a helicopter version of its four-engine, 44-passenger Sikorski transport. It plans because firm, post-approval probably will be American-made.

► First flight of the Guggenheim Aircraft Co.'s SR-32 light, multi-purpose helicopter (AW Mar. 5, p. 50) has been made with two passengers aboard. The first engine, engine-out test, lasted during the hour and a quarter flight, whereas test was very low.

► Constair expects to deliver 25 T-37A transport primary trainers to the Air Force in fiscal year 1968. Flying Training Air Force Headquarters, Waco, Tex., already has received order for 25 T-37A for evaluation and use in due to go to Eglin AFB, Fla., for Phase 7 operational suitability tests. Constair has received a new USAF order for T-37As totaling \$11,861,004. Earlier contracts include orders for 11 and 20 aircraft respectively (AW Sept. 24, p. 23).

► French's Dassault is reportedly engaged in studies aimed toward development of a long-range supersonic transport.

► Soviet parliament has vetoed proposals to purchase 40 French Mystere 4A interceptors to hedge the gap between Rikhs Vessons and the Su-26 built P-16, which is still in the prototype test stage.

► Air Force has ordered \$948,652 worth of aircraft test cells for F-4E, RF-4E and RF-4B aircraft from B. F. Goodrich Co.'s Aviation Products Division and another \$912,681 order for the cells with Goodrich Tire & Rubber Co.

Checklist for buyers of business planes

Now executive transport, new features, new performance; put them together, and they call for an entirely new set of standards before you decide.

- | | | |
|---|-----|----|
| 1. Is the aircraft prop-gated-powered—for performance, freedom from vibration? | YES | NO |
| 2. Is the cabin pressurized and air-conditioned—for comfort, for passenger safety? | YES | NO |
| 3. Is the cruising speed on a par with contemporary airliners? | YES | NO |
| 4. Can it fly more than 2,000 miles without refueling? | YES | NO |
| 5. Can it land and take off on small town airfields, with single runways less than 4,000 ft. in length? | YES | NO |
| 6. Can it double as a high-priority cargo carrier, with a capacity of more than two tons? | YES | NO |
| 7. Can it climb to 19,000 feet on one engine? | YES | NO |
| 8. Does it have room for comfort and work-environment? | YES | NO |

If the airplane you are currently considering rates even one "No" on this list, you may be settling for the second-best; if you've checked off all the "Yes" boxes, you have the Fairchild F-27 in mind—there is no other plane like it.

Address inquiries to: R. James Pfaffler, Executive Director of Customer Relations, Fairchild Engine and Airplane Corporation, Hempstead 15, Md.

FAIRCHILD
F-27 Friendship



Washington Roundup

Small Budget for Big Stick

USAF expects the Eisenhower administration will offer a total budget that is not much larger than last year's annual \$16.5 billion, or \$1.5 billion to \$5 billion less than it feels necessary. To perform his mission, Gen. Nathan F. Twining, USAF chief of staff, had better get heads in the neighborhood of \$21 billion. He was supported by USAF Secretary Donald A. Quarles.

Twining stood his own. Before the Senate Committee last June, Gen. Twining said Fiscal 1957's funds "represented a machine going...the riding up a rug in front of you. That's all it shows them and now we've had to get over it. We will have to get more money next year."

Now Fiscal 1958 is only a few months away, and there is small possibility that the administration will give Gen. Twining anything he wants, the "red."

In addition, it is attempting to increase U.S. military obligations with a threat to react with force any new Arab aggression in the Middle East. There is strong feeling in the Pentagon that the budget is going below Congress that much will require, but not seriously down, our power to wage total war and deter Russia from starting one. On the other hand, the same budget if it stands will give a devastating blow to our ability to re-emerge as a world power. Procurement programs will be suspended, and life here most cases will be the United Air Command. Planned purchases of fighters and tactical bombers will be cut back in order to support existing strategic aircraft and the missile effort. Top USAF officials are quietly worried at this prospect at a time when the White House wants to give a big stick in the Middle East.

USAF estimates that suspension of extensive new obligations in such areas as the Middle East could double the cost of doing the job and doing it right. Main reason is simple: USAF does not consider its deterrent in total war—primarily the Strategic Air Command—should be diverted from its prime mission to fight a localized war. In fact, it considers total war a greater possibility, if a local war is raging. It follows that the Korean would consider acceptance of total war if it was convinced that our deterrent power was weakened by SAC's diversion to a lesser one.

All in all, the expected budget is viewed by USAF as a tremendous risk, a "black at the future."

Vacancy of CAB

For the third time in three years, the White House has let the Civil Aeronautics Board start a new year with a vacant seat. Latest vacancy occurred Dec. 31 with the expiration of Joseph P. Adams term. Plans to take early action on the vacancy got on far in the decision not to appoint Adams but no successor has been named. The Board worked at reduced strength for months before Ross Relyea in 1955 and G. Joseph Minetti in 1956 took office, and the White House took longer than expected to find James R. Christie to replace Relyea in chairman last spring.

Wilson and Retirement

Defense Secretary Charles E. Wilson still poses questions about his intention to resign, if any. Pentagon betting still favors USAF Secretary Donald A. Quarles

to succeed him and it is assumed that Wilson will recommend his close colleague for the post. The time is not good, but it appears likely that the change, would come in the late spring or summer, after the defense budget has gone through Congress.

ALPA Accident Report

Air Line Pilots Assn. has produced its own accident report on the collision between Tamm World Airlines and United Air Lines bombers over the Grand Canyon last June.

In document which is identical in form with Civil Aeronautics Board accident reports, ALPA has published its own findings in advance of the CAB report, which is expected this month. The pilots union decided that the accident was due to limitations of several known major weaknesses in system inherent in transport aircraft: lack of adequate traffic information to pilots, and the inability of air traffic control to provide IFR information to all traffic on heavily traveled routes.

Amortization Reverse

Airlines are trying to get the Office of Defense Mobilization to change its stand on closing the amortization pool for commercial aircraft. But the closest of success can be seen. When ODM cut off the expansion pool, it eliminated the prospects of any state rapid air transportation certificate for commercial transport. The present pool, which was recently extended from 600 to 900 aircraft, has been heavily oversubscribed, and closing it leaves airlines with applications for fast certificates for nearly 400 aircraft with no prospect of getting selected certificates.

An Transport Assn. President Stuart G. Tipton has written ODM head Arthur S. Fleming, asking him to reconsider the ODM decision. Tipton points out that most of the jets ordered by the airlines are among the aircraft for which the carriers have asked for amortization certificates.

He argues that the national defense function of the commercial airlines qualifies them for further rapid amortization benefits.

Last time the carriers campaigned for more amortization two months, they got the pool raised by 300 aircraft. This expansion didn't begin to fill airline requirements, and they went back for more, this time trying to get an open end pool.

ODM has moved them down, along with the steel industry, and so on and so forth, and the prospects of a new pool are not bright.

New AIA President

Gen. Cyril R. Cook, former USAF deputy chief of staff for materiel, took over last week as president and general manager of the Aircraft Industries Assn. Gen. Cook, who succeeds Adm. Elwyn E. Ransaw in the post, was elected to the presidency at a meeting of the Board of Governors late last fall (AW Dec. 10, p. 28). The move was first predicted by Aviation Week on Aug. 23 (p. 25).

Adm. Ransaw has been named vice chairman of the board of governors and will remain with AIA as a consulting expert.

—Washington staff



USAF's Logair has been under a squeeze through contracts with commercial carriers for fiscal year 1977. Logair is existing largely on a contract with the Defense Department's new Military Traffic Management Agency. Logair is flying its direct route pattern as usual.

Logair Struggles to Keep Independence

USAF air-cargo line wants to retain identity, stay outside Defense's new single-management agency.

By Claude Witte

Washington—USAF's Logair, the nation's largest scheduled air cargo operator, is putting up a quiet struggle to keep its independence and survive outside the Defense Department's Military Traffic Management Agency (MTMA). Logair headquarters, at the Air Mail West Command, Wright-Patterson AFB, Ohio, just got a triple-die decision from the Pentagon yesterday that the "one line" is an outgrowth of the diverse existing MTMA.

Does MTMA, the single manager agency set up last October by Defense Secretary Charles E. Wilson, have any role in scheduled military air service or is its jurisdiction confined to "overseas airways" by commercial carriers?

No Plans for Change

When MTMA headquarters opened for business, it was made clear the agency expected to assume responsibility for the award of all fiscal 1978 air carrier contracts for all branches of the armed forces (AW Oct 14, p. 31). It

was evident then that Logair and the Navy's Quick Trac charter service probably would meet being swallowed. USAF's attitude last week was that Logair is operating as usual and has no plans to make any changes. Furthermore, Logair wants no change.

MTMA, on the other hand, feels it has been charged with the responsibility for negotiating contracts with commercial carriers and deciding what they will fund.

Aerospace Week has learned that there has been considerable concern on the subject between James H. Douglas, Undersecretary of the Air Force, and Robert C. Leighton Jr., Deputy Assistant Secretary of Defense.

Signposts of the problem is best illustrated by the fact that in the last fiscal year Logair will fly 260 million freight ton miles more than all the commercial cargo flown by domestic air lines. It will gain about \$25 million in its contract operations. Average cost, Logair claims, is 12 cents per ton mile.

The largest Logair contractor is Robert Anderson, Inc., of Washington D.C.,

which inaugurated DC-4 service in November, 1954 from a base in Oakland, Calif. The company says it is moving Air Force cargo at the rate of more than 50 million ton-miles a year. Outgrowing its fleet of Douglas DC-4 Skytrains, Robert has ordered two new Lockheed Super-H Constellation and has anticipated that its Logair job will grow to 75 million ton-miles a year by mid-1977.

Other carriers serving Logair are American Air Export & Import Co., Miami; Capital Airways, Inc., Nashville, Tenn.; and Riddle Airlines, Inc., Miami.

AMC Option

When first awarded their approved-air-cargo contracts for Fiscal 1975, the last contract was expected to submit alternate proposals for financing air transport cargo service for fiscal years 1977, 1978 and 1979. It was made clear at the time that AMC retained the option to extend the awards through these years, subject to availability of funds, evidence of a requirement and acceptable performance by the contractor.

Major Gen David H. Baker, AMC director of procurement and production, said last June that, in buying the

side made for a contract period with a two-year option, the Air Materiel Command could realize estimated savings of \$185,000 a year.

Turning the acquisition of the contracts over to MTMA potentially would introduce a new program in isolation to contracting from AMC's Airlift Division the power to set its routes and determine fully what will be carried on trips.

Logair Patterns

In the past, AMC's request for proposals from the contractors has been made on an overall cost basis for one or more of the patterns, or routes, to be served. For each of the patterns, there are established routes and timetables.

• **Pattern One: Round Airlines.** McCloud AFB, Wash., to Dover AFB, Del., with stops at Travis AFB, Calif.; Hill AFB, Utah; Wright-Patterson AFB, Ohio and others. Monthly monthly mileage: 405,744.

• **Pattern Two: Capital Airways.** Travis AFB, Calif. to Dover AFB, Del., with intermediate stops. C-46 aircraft. Monthly mileage: 142,720.

• **Pattern Three: Riddle Airlines.** Onward AFB, Pa., to Long AFB, Mo. carrying some intermediate points from other patterns. Monthly mileage: 405,744.

• **Pattern Four: American Air Export & Import.** Covert Texas, Oklahoma, New Mexico, California and Utah. Monthly mileage: 418,444.

• **Pattern Five: American Air Export & Import.** From Hill AFB, Utah, to 23 cities with AFB, S. L., Melbourne AFB, Meent, Frankfurt, Bonn, and McCloud AFB in Washington and back to Hill AFB. Monthly mileage: 74,671. Lt. Col. E. L. Schell, deputy chief of AMC's Airlift Division, emphasizes that Logair is not used exclusively by AMC. It serves all of USAF's contract awards and from time to time hauls cargo for the Army and Navy.

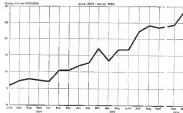


CHART shows increase in cargo handled by Logair since the service began.



RIDDLE AIRLINE, a Logair contract carrier, loads a C-46 at Wright-Patterson AFB, Ohio, for a test flight to the West Coast for further shipment to an overseas base.

But AMC probably is the one most afraid that on profit the cost from its operations. It was about five years ago that test operations were set up to prove that economies could be realized from use of scheduled air lift. In one of these, engines and electronic parts were supplied to a bomber wing, usually in the US & later overseas. In the second phase of this operation, one engine was used in a test run. The testing supply cycle of 30 days was cut to approximately 11.

Time Saving

A second domestic test involved moving cargo to Strategic Air Command bases from its critical and production plants. The second 30-day cycle to get an engine from SAC to production and back again was cut to 75. Surface shipment would have required an additional 25 engine in transit. That cost \$146,880.

At least profits on the basis of this experience, Logair was awarded a little more than two and a half years ago.

- The objects are more defined.
- To provide AMC with a guaranteed and dependable inflow of profit-making for DDA.
- To expedite the delivery of critical and high-value items, rendering air shipment, pipeline, railroad and ocean transport.
- To determine for AMC what route should be utilized to USAF units.

In April 1954, Military Service the initial Logair schedule with C-46 aircraft was launched. There were contracts for the Eastern and Western areas. On the first circuit, there was a round-trip service out of Kelly AFB, Tex., northeast to Waco, Tex., and back again. On the second, flights went from Kelly, northeast to McChord AFB in Washington.

Cost, Route-Miles Gap

AMC figures show that 358,617 man-hours were flown in the first month. Load factor was 92%, total cost of the operation \$262,680. When Robert introduced DC-4 service in November of that year, tonnage jumped from about 4.5 million lb. to 6.5 million lb. Cost rose to \$407,060, route miles to 546,646.

All costs have gone up in the past two years. Last August, for example, Logair saved 16,676 man-hours. Tonnage was 11.8 cents and contractors were paid \$3,195,480. The load factor was 73.1%. Service was provided to 53 stations—12 of them AMC bases, the rest supplying points for that command's "customers."

If MTMA takes over contract negotiation for Logair and determines what a shall call, the single manager agency claims it will make better evaluation of the available space. It may mean the end of AMC's priority status and the subordination of another one that USAP looks upon with some skepticism.

It is equally certain that MTMA will charge Logair with the Navy's Quick Trac, a coast-to-coast air op-

ated by Colombia Eastern Airlines, Inc.

The final major possibility, MTMS, might reduce the magnitude of the two services, substitute greater reliance on existing scheduled commercial air cargo facilities.

This would be an obvious anathema to Air Marshal Goodman and the Navy, who see these facilities offer no proper contribution to their mobilization potential.

Argentina to Build T-34 Under License

Berth Aircraft Corp. will build 15 T-34 fighters at its Wichita, Kan., plant and ship the balance of an order for up approximately 50 to Argentina. Berth also will under a 58 million contract with the Argentine government.

Berth will provide technical assistance for the assembly operation at Córdoba, Argentina. Contract is the first licensing and technical agreement between a U. S. manufacturer and Argentina since World War I. Argentina, which will have the means equipped for armament systems training, is the seventh foreign nation to buy the T-34 and the third to sign a licensing agreement.

First Flights Made By F-106A, FJ-4B

Two new versions of supersonic fighters—Canada's F-106A and North America's FJ-4B—have made first flight.

The F-106A is the redesigned F-102B, and differs from the F-102A mainly in the change from the Pratt & Whitney J57 to the more powerful J75 engine.

R. L. Johnson, chief engineering test pilot at Edwards AFB, Calif., for Convair and head of the F-106A test program, was the pilot on the 20 min flight.

Convair has 583 million contract for the F-106A.

The FJ-4B, flown from North America's Columbia Division at Fort Lauderdale, Fla., is an F-4 Phantom II for low altitude attack operations (Longitudinal, lateral and directional control system improvements have been made for very low altitude high speed operations, and a low altitude bombing system is added).

Weight J05 cannot developing 7,500 lb. thrust power the FJ-4B.

Convair also proposes a newer development of the F-102 series, tentatively designated F-106C. It would have a top speed of well over Mach 2, incorporate an advanced development of the J75 and feature a stepped vertical fin and round design (AW Dec. 3, p. 13).



VERTICAL firing, analysis for twin jet engines are mounted in this fully armed.

Soviet Twin-Jet Supersonic Farmer Details Are Shown

Russian fighter, code named Farmer by NATO, can reach 48,000 ft in about 2 min. 7 sec. after takeoff. New model shows small wing and low jet bill as opposed to MiG type. New model is small, but features 8000 and 10000 shv engines, believed to be used for both types of engine design (AW July 2, p. 26). Sharp nose probe located at bottom of intake does not appear on model, but shown on photographs (AW July 2, p. 30). Farmer is in 900 mph class, can often Mach 3 in level flight. Long fuel tankage contracts with level flight MiG 15 and MiG 17.



VERTICAL to 8000 shv engines, extends well off of fuselage.



ROUND intake in the high altitude performance. Split intake is shown (AW July 16, p. 32).



SWEPTBACK of wings and increased stability is 32 deg. Delta hole appears in leading edge of stabilizer at mouth.



British Air Exports Estimated At Record \$294 Million in 1956

London-British aircraft industry's record exports are expected to total \$295.4 million for 1956.

Preliminary figures given by the Society of British Aircraft Constructors show the following export breakdowns:

- Aircrafts \$201 million
- Engines \$76 million
- Components \$17.4 million

This is an increase in exports of more than 90% over the past two years and establishes Britain as the nearest competitor to the U.S. industry. Final British figures are due in three weeks.

The company, Inter-Department of Commerce figures for U.S. exports of complete civil aircraft and parts alone January-September, 1955, totaled \$99.5 million.

BRAC tops the record trade trade with British industry policy and both sides excellence in recent years. Re-cent contacts give rise for quiet optimism in the future. The BRAC adds its answer to those who have claimed the record BRAC being display at Farnborough. The society now there is a direct relationship between the flying display and the rapid expansion in export trade. The 1957 display will be Sept. 2-6.

BRAC notes that Viscount orders

Finland Licensed To Build Gnat

London-Finland has signed a license agreement for construction of Finland's first light-weight fighters in that country.

The agreement follows an order for 12 Gnat's placed last year (AW Nov. 12, p. 14). The British-designed aircraft will be built by Valmet Oy at Tampere in Finland. Finland will train Finnish engineers at the Southampton plant.

Finland is expected to buy components in aid of pay and trade from British manufacturers. Arrangements for manufacture of the Gnat under license in India already are underway, in addition to an Indian order for the Gnat.

The Indian Air Force will build the Gnat at Bangalore, India.

During the year mentioned more than two a week. Twenty three Bristol Britannas were sold during 1955 five of them to Northern Airlines. Capital Airlines purchased 14 Conquest in no other large daily sale.

In addition, there were orders from

Holland for Sea Hawks, from India and Sweden for Gnats and from Denmark for Harrier. Western Germany ordered more than 100 aircraft of varying types, the society reported.

A large part of the industry's profits are being plowed back for development and research, the SABC said. It noted that the Conquest aircraft during the first years spotlighted the RAF's shortage of modern transport aircraft.

Yet, and the need to build up a reliable home market for large aircraft, was again emphasized during the year, a spokesman said.

Cessna 310 Wins Lightplane Contract

Wright-Patterson AFB, Ohio-Cessna Aircraft Co. will receive a \$5 million USAF contract for 80 Model 310 light twin-engine aircraft for Air National Guard's uncommitted lot.

The award is the first under AMCA's new policy of buying "off the shelf" planes when USAF needs a model also available on the commercial market.

The 310 is a four-place metal aircraft with a cruising speed of more than 200 mph. USAF will use it for liaison and light cargo missions.

Three other manufacturers submitted proposals in the competition. Centers near the contract after a joint evaluation by AMC and the Air Research and Development Command.



Artist's F-105—Partly Right, Partly Wrong

This drawing by a Japanese artist of Republic F-105 Thunderbolt has several radical misconceptions about Indonesia—but also is close enough to the actual airplane to confuse the artist had more than a school description, compare any. Background is authentic—the flight base at Edwards AFB, Calif. As described by Republic, F-105 has short, very thin sweptback wings, long cylindrical fuselage, complete fuselage tail set back on aft fuselage, and vertical fin. But in drawing do not appear to conform with company description, which has them set in wing box (AW Aug. 6, p. 418). The artist is known to have visited Edwards.

Congress Girds for New Aviation Battles

By Katherine Johnson

Washington—Congress begins its new session last week with such lights over military and commercial aviation already in the offing.

On the military side, the Executive Administration has cut between \$3.3 billion and \$5 billion from USAF's Fiscal 1958 budget requests. The cut probably will be a springboard for the Democratic majority's attack on the administration's overall defense policy. The battle will be touched off by these developments:

- Release of the Senate Air Power Investigating Subcommittee's report. The subcommittee, headed by Sen. Stuart Symington (D-Md.), will issue a report highly critical of the administration's defense policies based upon hearings held last spring, during which the commander of USAF's various commands testified to the need for more funds to meet the increasing Russian threat. Sen. Symington says he "hopes" the report will be unanimous.

There is little likelihood, however, that it will be.

One of the Republican members of the subcommittee—Sen. James Duff (R-)—was defeated in the November election. The House Democrats in the subcommittee—Symington, Sen. Henry Jackson (D-Wash.), Sen. Sam Ervin (R-C)—are expected to sign a report criticizing the administration's defense policies down the line, with a concluding remark about the Sen. Leverett Saltonstall (R-Mass.).

- Readings before Senate Armed Services Committee of which Symington

is a member—and the House Armed Services Committee. These hearings probably will furnish the basis for the challenges of the administration's defense policies by Congressional Democrats.

Civil Aviation Controversy

In civil aviation, the same controversy will be over the role of the unscheduled lines.

The Independent Military Air Transport Association and Air Coach Transport Association will push for legislation authorizing the Civil Aeronautics Board to grant certificates to "supplemental carriers" for limited scheduled without flying and operating. The move will be opposed by the Air Transport Association. ATA will argue that the CAB already has authority to give non-scheduled certificates without such charter service, and that this is to be cut off, etc. ATA fears that new CAB authority to limit the schedule threshold might also be used against the scheduled lines.

Agreement on MATS

On one proposition, however, there is basic agreement among the scheduled and non-scheduled groups—that the Military Air Transport Service, now organized as a unitary system (AW Dec. 17, p. 34), should be primarily open contracts with non-scheduled operators for its service. Congress the issue toward the vote. The House Appropriations Committee last July noted it "recognized the strategic importance and necessity of a strong MATS type operation (but) at the

same time it is apparent that commercial airlines, including scheduled and non-scheduled airlines, are an essential part of the overall national transport strength of the U.S." The commercial carriers, the report said, "will provide a major part of the ability to fly the nation to meet the large demands for transport in the event of a sudden war emergency."

More Investigations

More investigations also are in the offing.

- Senate Permanent Investigating Subcommittee will open hearings within a few weeks on the alleged trading of Northeast Airlines shares after the CAB granted the carrier a New York-Miami route in exclusive service. Wall Street trading jumped from 150 shares on Aug. 2-10 to 1,000 before the CAB's return to open 20,000 shares on the following morning. The CAB decision was made public on Aug. 10.

- House Appropriations Armed Services Subcommittee headed by Rep. George Mahon (D-Tex.) has been carefully following government practices in the procurement of aircraft and related equipment and profits allowed. Other subcommittees are expected to cover the same territory as various aviation groups.

Members of the appropriations committee of the two houses also will play a prominent part in the aviation debate. After hearings last July, the Senate Appropriations Committee decided that it had "had enough" knowledge to its attention frequent examples of duplica-



Short SC.1 Begins Test

Short SC.1 is British vertical lift aircraft aircraft built around jet, Rolls-Royce R.510 turboprops similar to the Scout. Latest is a delta wing of that aircraft mounted on a short body, fixed landing gear is used. Current problems, planes low at the expense of a control group disintegrating downward into vertical lift and the 50th of the tail in the conventional position for forward propulsion. First control jet-at weights, fuselage nose and tail—provide stability and control during hovering and landing in forward flight. Control and stabilization system was developed by Short in collaboration with Royal Naval School of Aeronautics, Farnborough. Presently this system was tested on the Flying Bedouin test jet built by Rolls-Royce for RAE as a control test vehicle. Testing took place began with the SC.1. Development is being done at the Cranfield plant of Short Brothers and Heland, Ltd., Belfast, Ireland.



Retractable ski hook can be used alternately with tandem landing wheels on Lockheed C-130 Hercules; will be tested this winter at Rensselaer. Main arm emergency doors have 131 ft. x 51 ft. area; side and M-131 ft. area also will fit on the airplane. Weight added is approximately 4,400 lb. Installation is designed for operations from unpaved airfields or from conventional paved runways.

Lockheed C-130 on Skis

line of facilities and functions through out the Department of Defense. In some cases, it added, "This department handles an unresolvable waste of the country's resources, not only in material, but in land resources, manpower, and money." The committee has directed the Defense Department to file a report by June 30 outlining the steps that have been taken to assist displaced fire activities.

Air Traffic Control

Debate and on-hill argument and pressure in the Senate indicate the new Democratic Congress can have even the course of the airport program.

The three down votes, as always, will be as budgetary proposals that the staff stands that an administration not concerned at the work does not use money—even if it has been appropriated by the Congress.

The debate over funding for air traffic control facilities probably will not be moved until the spring voting on appropriations. Railroad representatives can be counted upon to try and hold the funds to a minimum, arguing that the rest should be spent by the airlines.

To counter that, congressional appropriations committees are expecting a report recommending methods of increasing the rates of airlines. Under Secretary of Commerce Joe Thompson told Lewis Rothchild presented it in testimony last summer.

The particular legislation wanted by the scheduled laws is a revenue authorizing revenue to "air-side" safety insurance for use in financing equipment purchases. IMATA will not oppose the move, but financing unencumbered laws probably will.

Navy Quits Joint IRBM Project, Confirms Plans for Own Missile

Washington—Navy confirmed last week that it is pulling out of the joint Army-Navy intermediate-range ballistic missile program to develop its own IRBM at fast reported by AVIATION WEEK last Feb. 20 (p. 30). The Navy IRBM has been designated the Polaris. The basic event behind the split, as detailed by AVIATION WEEK on Feb. 27, (p. 34), is Navy's requirement for a solid-fuel rocket with a relatively simple configuration to meet deployed storage, handling and launching problems. "The larger, more complex vehicle under the joint program, as a further development of the Army's long, thin and liquid-fueled Redstone.

Major contractors for the Polaris are Lockheed Aircraft Corp., General Electric Co. and Aerojet General Corp.

Abandonment of the joint program by the Navy is the second major blow to Army's missile efforts.

A month ago, Defense Secretary Charles E. Wilson took responsibility for "agencies' employment of local-based IRBMs" from the Army and gave it to the Navy. Leaving the Army has led to major facilities under the IRBM (AW Dec. 1, p. 34). Some Pentagon observers believe that Army's reaction of designers and engineers will back up without Navy support and with little prospect of future work on solid-fuel ballistics missile.

The Polaris is the fourth solid-fuel intermediate-range missile program being conducted in the West. Besides

Jupiter, often the Air Force's Thor and a British program (AW Feb. 17, p. 34).

Polaris will be capable of autonomous firing from submerged submarines as well as from ships. Rear Adm. John E. Clark, director of the Goddard Space Division in the Chief of Naval Operations' office, said in Senate testimony last May that the Navy would be "unsatisfied" over the fact that the Polaris missile will take "six weeks" to test, and that "it would build a vulnerability and have it ready shortly after the missile is in service."

The Navy also has talked of using battleships or large cruisers as mobile launching platforms for the missile.

News Digest

Lee S. Johnson has been elected general manager of Sikorsky Aircraft Division of United Aircraft Corp., succeeding Bernard L. Whelan. Whelan will continue as a vice president and as a member of the operating and policy committees of United. Johnson is former senior assistant general manager.

Two new Assistant Secretaries of Defense have been appointed by President Eisenhower.

*Maurice D. Spurgeon, who will be in charge of manpower, personnel and reserve affairs replacing Carlos L. Baggett, who resigned to become president of



Trident 2 In Flight, Ground Tests

Fourth Trident 2, in first flight (above), is powered by a combination of GE38 liquid-propellant rockets in tail and turbojet engines mounted on wings. Powerplants of first 33 down will be General Electric J44 turbojet engines. Weight of 16,000 lb. about each. Next 10 will have turbofans. GE38 engines rated at 2,400 lb.

Trident 2 (top right) compares with Trident 1 (bottom right) in showing a folding wing. Trident 2 has two rocket engines, not three, and landing gear has been lengthened and redesigned. Span of Trident 2 is about 35 ft., compared with 27 ft. of Trident 1. Small downward pointing fins on horizontal stabilizer of Trident 1 have been eliminated.

Single rocket engine is test fired below. Turbogroup exhaust is carried off a pipe from belly.

Orion Aviation, which builds Trident, says it has testing ability in high speed wind tunnels (AW Nov. 1, p. 34). Coming in loaded by pilot vulnerability at high altitudes.





B-58 on Takeoff

Indicates at how the long nose landing gear of Canada's B-58 Hustler supersonic bomber is gone in these offset photographs. Shots are pointed to prove aircraft is not directly exposed to 81 in wing stresses caused by down in process of clearing in the two photos. Factors of control center of wing stressed to a point. Note critical angle in variable geometry, when in lower velocity climb was at supersonic speeds (A9, Dec. 17, p. 26, Dec. 31, p. 20). Another Mark first revealed the control center technique in the Nov. 26 issue (p. 36), followed with exclusive B-58 picture in the Dec. 17 issue.



Firm World Airlines (AW Dec. 10, p. 39).

Edward P. McGuire, who will be in charge of supply and logistics, replacing Thomas P. Pike, soon a special adviser to Defense Secretary Charles E. Wilson.

Auto Digest Magazine suspended publication with its December issue. The monthly was founded by Charles J. Glidden in New York in 1922.

Eastern Aircraft Corp. (Hawthorn, N. Y.) will be acquiring North American's share of the Louis Requet Co. of France. Budget is manufacturing 15 BA-765 four-engine passenger/cargo transports.

Strategic Air Command flew 14 missions in unannounced combat missions in 1956, completed more than 750,000 attacking missions. Accident rate in heavy fighter schedule was 11 per 100,000 flying hours, including losses at well as major accidents.

Canadian Ltd., with flight tests imminent for CL-28, has added Paul F. H. Jones to its test pilot staff. H. Jones, who was second pilot of the Bristol Britannia on its North American tour, has logged 500 hr. in the Britannia. CL-28 is a piston engine transport (Canadian version of Lockheed Constellation) to be used by the Royal Canadian Air Force, which has ordered the CL-28.

North American Aviation relied on the fact of more than 5,000 Sabre jets, bringing production in the U.S. to a close. Production under license continues in Canada, Italy, Japan and Australia. L-500 line at North American's Los Angeles plant has been converted to production of F-100, now place orders of the F-100 Super Sabre.

Rockwell Aircraft Corp. will offer \$7.5 million of convertible subordinated debentures due in 1977. Offering, which will be underwritten by First Boston Corp. and Lederer, Kohn & Co., will be used for some plant modernization and expansion, and to reduce outstanding short term bank loans.

Aircraft industry backlog, estimated in Commerce Department at \$19 billion at the start of 1957, is a one-third increase over backlog at beginning of 1956 and the highest level since World War II, the department reports.

Frederick Traub Co. will build conversions transports and bombers for USAF's Military Transportable Aircraft. Subcontract from Convair Aircraft Corp. is for more than \$2 million. Traub will be built at 3 million x 17. Wayne, Ind., plant.

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Benjamin Franklin



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TWA provided only material and has refused to do with distribution or profits. Naturally the book, (which was on the books list and has reached 200,000 distribution, Van Der Meer) doesn't miss. TWA's advertising people unhappy.

Arguing with publishers to put out the books, at Pan American days, restricts the degree of plugging that can go into some of them. The cockpit, the instant mentions Pan American's some springs and sketches of Stinsons in the handbook, editors show welcome interest on the aircraft.

Lord North's position is enough, however, and before the airline could be awarded with much heavier plugging. In any case, he prints out, the potential role in the future.

Most fascinating aspect of the guide books of both airlines is their value to air travelers and the general strengthening effect on travel.

American Extends Luxury DC-7 Service

American Airlines is extending its de luxe "Moroccan" service to new cities in addition to New York, Washington and Los Angeles.

The DC-7 flights are scheduled for inauguration June 15 at Chicago, San Francisco, Denver, Boston, and Cincinnati. Dallas, Fort Worth, Tucson and Phoenix will be added as Feb. 3 "Moroccan" flights become regular service, and the "red carpet" toward service.

PanAm Borrows for Jet Aircraft Program

Pan American World Airways has arranged for \$10 million in additional financing for its corporate program, particularly jet aircraft acquisition, the airline recently announced. Program involves sale of passenger seats, some carrying 4175, aircraft with first scheduled scheduled for 1960. There is provision for extension to 1965.

Financing was negotiated with a group of institutional investors in London, Boston and New York and Wichita, the airline reports.

Japanese Airline Gains Brazil Entry

Rio de Janeiro-Brazil and Japan agreed to accord to permit regular Japan Air Lines flights to Brazil. Air transport from Japan to Brazil has been irregular and in the Brazilian context, has made the trip to Japan. Likewise, Rio de Janeiro is expected to make a full run to Tokyo in the near future.

Pan American Gets U.S. Rights For New York-Nassau Service

Washington—Pan American World Airways has won U. S. rights to compete with British Overseas Airways Corp. for traffic between New York and Nassau.

The Civil Aeronautics Board, with White House approval, chose Pan American as the U. S. carrier for the route provided for when the U. S. United Kingdom bilateral was renewed in August 1955.

Pan American was given the route on a light 5-2 CAB decision. Vice Chairman Joseph P. Adams and Member G. Joseph Mailliard, Eastern Air Lines, for the route.

In an attempt to keep Pan American out of the New York-Miami market, the CAB imposed a restriction on the exclusive certificate that prohibits the carrier from operating single plane service between the two points via Nassau. The airline was also prohibited from advertising a New York-Miami service. Indeed, the price factor in the majority decision to give the route to Pan American. CAB believes revenues from the New York-Nassau operation will offset PanAm's subsidy costs.

In its decision, the Board takes an optimistic view of traffic growth on the route. Projecting that Pan American will capture 60% of the market, the Board estimates that the U. S. flag carrier will fly 37,400 passengers and operate 11,931,000 passenger miles over the route this year.

Based on historical trends, the traffic estimate, the CAB believes Pan Am's new airframes from the route will total \$2,311,000. The Board estimates expenses for the first year of operation at \$1,511,000, leaving a \$500,000 profit to help cover the carrier's subsidy.

In case of these optimistic forecasts, the Board rejects the examiner's recommendation that Pan American be restricted from operating through the New York-Nassau operation. The Board said: "We are satisfied that Pan American will promote and develop the market involved successfully, that the interests of the New York-Nassau route and the nature of the monopoly operations in Pan American will make any subsidy problem academic."

The CAB agrees with Pan American's estimate that the introduction of competitive American flag direct service on the route will generate a 75% increase in traffic. The Board said the proposed service will provide a faster, more efficient, lower cost service than that presently available. Since BOAC offers only two coach flights a week between New York and

Nassau, the CAB feels the coach potential is relatively undeveloped and that Pan American's proposed daily coach service will stimulate the market.

Another stimulus to traffic growth described by the CAB lies in the fact that Pan American plans to offer substantially lower fares than those now offered by BOAC. Pan Am's new proposed tourist fare is \$100.00 round trip, \$55 one way. American fare is \$145.00 round trip, \$75 one way. BOAC charges \$185 round trip, \$95.00 one way tourist, with an off-season round-trip economy fare of \$150. BOAC's first class is \$185 and \$201.00. Explaining its Miami restriction on the new service, the CAB said the conditions imposed "will make it clear that Pan American is not authorized to offer air service to the public a New York-Miami service, whether by regular, irregular, or seasonal service. Pan Am will be permitted to sell through tickets between New York and Miami."

Without this restriction, Pan American would be able to offer a through service by taking the new route with its Nassau and Miami stops. The CAB agreed with the examiner, who also chose Pan American, that the new service integrates well with the existing transportation of 11 airlines' heavy aircraft traffic across the Atlantic. The Board also pointed out that operating economies will result from the fact PanAm is established at both New York and Nassau.

The CAB found that the other two major applicants—Eastern and National Airlines—were capable of handling the route but not the advantages of traffic control Pan American deems that choose. Mailliard believes the monthly flight cost was raised down because the CAB said the Florida airline bids to operate in New York and would have to operate with the competitive handicap of equipment, DC-7 equipment.

Adams and Mailliard disagree with the argument on the subsidy issue. They maintain that Pan American's case is the weakest of the three applicants because of the possibility of excess will require subsidy for the new route.

The members members found Eastern for the route because, they said, it will suffer greatest because of the decrease of Nassau traffic now flowing through Miami.

Adams and Mailliard dispute the cost estimates used in the majority's decision. Pan American, they said, will lose about \$3,740,000 on the new route in its first year of operation with the subsidies proposed by the airline.



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SHORTLINES

► **Aerovias El Estudiante** is the first South American airline to buy the Fairchild F-27. The Ecuadorian carrier, which now operates a fleet of DC-3s, has ordered one F-27 and taken an option on another.

► **Airline Stewards and Stewardesses** are looking for a "Miss Spirit of St. Louis" to help commemorate the 100th anniversary of Charles Lindbergh's flight across the Atlantic. A stewardess from each U.S. airline will be chosen before the final selection, which will be made in time for the premiere of the motion picture "The Spirit of St. Louis" in May.

► **Alleghe Airlines** has purchased its fifth Martin 2-0-2 and plans to add two more. The carrier will take delivery on the first Martin this month, the second in early spring, and the third at a yet undetermined date.

► **Banque Axa**'s shareholders have approved the board of directors' plan to issue up to \$40 million worth of equipment mortgage sinking fund bonds. The long-term bonds will be sold in French on or about April 26, 1961, to an insurance company group including Mutual Life Insurance Co. of New York, the Equitable Life Assurance Society of the United States, The Prudential Insurance Co. of America, New England Mutual Life Insurance Co., The Northwestern Mutual Life Insurance Co., Connecticut General Life Insurance Co. and The Guaranty Mutual Life Insurance Co.

► **Capital Airlines** now has an all-Vietnam operation at New York with 40 tailcocks flight to a day scheduled out of Newark, LaGuardia and Newark Airports.

► **International Air Transport Assn.** (IATA) House of Representatives has approved a new \$750,000,000 fund for the first nine months of 1961, a 32% increase over the volume for the same period in 1955.

► **Jepco Air Lines** carried more than 25,000 passengers and 430 tons of freight last year, increases of 40% and 87% respectively over traffic in 1954. Business passenger load factor for 1956 was 84.5%.

► **Northeast Airlines** reports operating revenues of \$55,989,000 and a net profit of \$1,272,000 for the just year. It reported net revenues of \$12,246,000 and net profit of \$2,116,000 for the previous year.

AIRLINE OBSERVER

► **Northeast Airlines** has leased an 85-passenger DC-6A from Flying Tiger Line and will begin day and night coach service on Jan. 9 over its newly acquired New England-Florida run. A single day coach weekday flight will be operated every day except Wednesdays between New York (LaGuardia) and Miami with this airplane. The DC-6A also will be used on one night coach flight from Miami to New York on Tuesdays only, and on a night coach flight on Thursdays only from LaGuardia Airport to the Florida port.

► **British Airlines** are facing a severe pilot and navigator shortage and are conducting an extensive recruiting campaign to avert the problem. High cost of flight training is given as the primary reason behind the declining ranks of flight crew prospects.

► **Market study** presented by R. E. Foster of Frontier Airlines at a recent Air Transport Assn. Purchasing Committee meeting forecast a stable market of about \$1 billion in 1957 when labor-management negotiations to lower industry will be completed. Aluminum supply is considered adequate but imports of brass, copper and lead are unable to become of the increased international situation. Steel prices are rising up and price advances 5 to 10% on stainless steel and nickel were forecast in the study by Foster.

► **Riddle Airlines** handled more than 40 million lb. of cargo in 1956, an increase of 30% over the previous year. The carrier expects to ship more than 60 million lb. this year.

► **Carrollville** jet transport now undergoes engine modifications designed primarily to lower fuel consumption to conform with Society of Automotive Engineers standards. The modification is being studied by Sud-Est with 70% toward U.S. sales and will not affect 12 Carrolls on order by Air France.

► **Regulations** allowing the exchange of air transportation for advertising goods and services by local service airlines has been extended an additional year to Dec. 31, 1957, by the Civil Aeronautics Board. The Board also approved a request by the carriers that the ceiling on values of the trade agreements be increased from \$50,000 to \$500,000 annually for each local service airline. CAB refused to grant a request that the program be extended for two years on the grounds that the trade agreements are still in an experimental stage.

► **Canadian Pacific Airlines** has applied to the Canadian government for an extension of its Mexico City-Toronto route to Liberia on Montreal. Part of the carrier's argument is the fact that the growing need for greater Canadian participation in the transatlantic market. CPA does not now serve Montreal, and an earlier offer Montreal-Liberal service failed.

► **United Air Lines** set a new company record for mail ton-miles carried in a single day on Dec. 19 when 104,645 mail ton-miles were handled, a 9% increase over the previous record established Dec. 20, 1955.

► **Eastern Air Lines** has been authorized by the Civil Aeronautics Board to lease one DC-7A from Pan American Airways, Inc. for \$600 per month per month. Three of the aircraft will be leased until May 15, 1957, and four until June 15, 1957, with an option to lease a maximum of five until June 1, 1955.

► A **Provision airline** has been formed in Lima with plans to operate a scheduled service between Lima and Lima. The airline owns two Cessna 440s, holds an option on a third.

► **Lockheed Air Terminal, Inc.** will make a financial study for the proposed \$12 million Honolulu International Airport Terminal. Study will include recommendations on the Alcoa Aluminum Company's development of jet traffic, establishment of jet structures and changes development of non-jet traffic revenue-producing activities in the terminal.

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SPECIFICATIONS

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[illegible]

Other symptoms include fatigue, loss of appetite, loss of interest in sex, and loss of interest in work or activities. These symptoms are common to many conditions, so it is important to see a doctor for a proper diagnosis.



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Airline Income & Expenses—October 1956

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Subsidy	Total Operating Income	Total Operating Expense	Net Operating Income (before taxes)
DOMESTIC TRUNK								
American	\$215,989,181	\$400,837	\$229,219	\$1,686,949		\$99,461,652	\$20,959,707	\$78,501,945
East	2,743,972	106,448	52,011	127,341		6,899,698	5,474,722	1,424,976
North	4,344,114	122,652	48,459	191,378		8,697,449	6,738,339	1,959,110
Capital	554,260	38,420	11,117	67,009		1,075,822	3,314,341	1,089,771
South	3,293,694	106,123	117,446	108,929		5,594,168	3,664,622	1,929,546
Trans	16,345,642	379,342	398,060	911,428		16,245,399	12,401,990	3,843,409
National	3,046,472	76,832	28,354	111,556		6,444,412	3,210,233	3,234,179
Intercontinental								
Alaska	3,341,414	110,639	61,918	397,730		9,681,652	4,476,704	5,204,948
Trans World	16,699,414	389,275	244,819	390,169		16,142,861	12,896,271	3,246,590
United	19,419,658	792,124	287,463	1,344,213		22,549,458	19,718,328	2,831,130
World	2,907,227	62,650	36,003	64,687		3,210,243	2,754,448	455,795
INTERNATIONAL								
American	\$208,349	\$10,418	\$23	\$1,373		\$19,359	\$49,419	\$18,073
Capital	418,187	117,292		39,618		645,124	345,948	299,176
Continental Atlantic	96,458	3,722				188,457	184,112	4,345
Delta	288,494	4,410		14,843		488,194	397,240	90,954
North	1,163,232	33,399		37,343		1,326,793	1,097,591	229,202
Western	1,259,730		1,478	7,419		1,267,627	388,306	879,321
Worldwide	1,229,412	\$66,452	\$44,162	\$30,424		3,220,495	3,169,440	51,055
Pan American								
Alaska	364,500	19,205		49,860		438,564	673,908	235,336
Atlantic	8,201,550	299,403		\$24,000		10,198,064	9,499,484	1,698,580
Europe	4,644,020	99,519		140,300		6,822,839	5,293,409	1,529,430
Latin America	4,444,505	241,200		977,600		9,668,310	7,257,618	2,410,692
Pacific	1,289,944	1,187		128,312		1,489,447	1,662,743	126,704
Trans World	4,308,713	305,908		380,116		4,714,647	3,291,709	1,422,938
United	661,193	34,243		101,772		1,662,448	1,027,767	634,681
LOCAL SERVICE								
American	\$450,329	\$7,129	\$13,515	\$1,426		\$61,207	\$66,498	\$39,314
Alaska	100,563	3,841	1,738	1,208		168,345	166,476	1,869
Capital	121,908	5,491	5,814	3,243		192,458	268,516	76,942
Continental	247,004	3,200	1,400	96,487		357,691	331,186	26,505
Delta	594,522	5,981	6,132	19,378		629,360	347,104	282,256
East	441,467	8,338		8,066		521,894	474,146	47,748
North Central	17,520,911	17,530	18,091			19,740	720,694	750,194
South	438,401	332,623	5,800	9,179		648,663	841,463	193,139
Trans World	429,769	7,744	4,561	8,273		522,146	420,328	101,818
Western	378,468	7,710	4,561			524,380	367,708	156,672
Worldwide								
Trans World	\$190,450	\$9,306	\$2,727	\$2,618		\$9,454	\$16,363	\$23,455
United	770,911	9,444	3,642	3,793		104,764	348,811	18,414
TRUNKS								
American	\$197,818	\$2,010		\$6,294		\$79,698	\$69,194	\$10,504
Trans Pacific	149,700	\$90		\$,081	4,181	147,163	146,499	\$666
CARGO LINE								
American Sky Airfreight ¹								
Alaska Sky ²	\$27,157			\$33,204		\$64,884	\$1,253,190	\$1,088,306
Capital ³								
Delta ⁴								
Hubbards & Wadsworth ⁵								
MALCOLM								
New York Airways	\$7,768	\$,427	\$,233	\$,940		\$99,794	\$16,462	\$83,332
Los Angeles International Airways ⁶	\$3,431	\$,879	\$,268		\$5,279	\$9,734	\$3,544	\$6,190
BLAIRLINE								
American Airlines	\$123,230	\$2,194	1,182	\$5,794	45,536	\$49,846	\$21,812	\$28,034
Alaska Cargo	\$3,508	\$,872	2,092	\$7,380	\$7,380	\$8,090	\$97,493	\$89,402
Centra	4,101	\$4,445		\$,208		\$128,138	\$9,244	\$118,894
Delta Air Cargo	\$3,359	\$,229		\$,730	\$1,730	\$71,720	\$8,728	\$62,992
Northwest Consolidated	18,137	\$6,858	220	\$7,214	142,078	\$75,140	\$91,480	\$83,660
Pacific Northwest	\$912,810	\$74,239		\$7,161		\$416,341	\$20,158	\$395,183
Trans World	\$4,378	\$,199	\$,146			\$76,284	\$7,824	\$68,460
Wan Airline	\$8,345	\$1,140	\$,000	\$9,113	\$5,712	\$28,419	\$39,448	\$11,469

^aNot available.
 Calculated by dividing the 1977-1978 mean sales results by the Civil Aeronautics Board's



HYPERSONIC TEST VEHICLE is shown, marked by smoke (right), curves toward vertical after launch at Edwards Air Force Base, N.M. Time exposure of night firing (left) shows its such deviation. Vehicle has reached 5,000 mph at 50,000 ft altitude.

Hypersonic Test Vehicle Moves Toward

By Irving Stone

Los Angeles—Originally projected for speeds of about 10,000 f.p.s. (5,600 mph), the hypersonic test vehicle (HTV) developed by Ames Research Development Corp., Alameda, has reached the 5,000-mph mark at altitudes in the region of 10,000 ft.

Amesbury, a subsidiary of Convair Wright Corp., developed the HTV in cooperation with Air Research and Development Command's Wright Air Development Center (AWDC Sept. 17, p. 36).

Cost and Description

Twenty-eight of these hypersonic research vehicles have been fired at Holloman Air Development Center, N.M., since the first firing in November 1954. Cost of the HTV ranges between \$50,000 and \$75,000.

Research is a two-stage assembly of solid propellant rocket motor and a nose-payload section, the total weight, approximately 370 lb., is 12 ft. 10 in. long. Booster stage has seven rocket motors and three fins; the second stage has two rockets and four fins.

The grouping of different members of the rocket motor is chosen and its arrangement chosen in stages, a highly flexible family of flight-test vehicles can be selected. Special-purpose vehicles

can be constructed very close to an assembly line loss, Amesbury reports. New information on the HTV reveals the word's applications, outsize, and proven techniques. Some of these details were outlined recently by David Shoenberger, Amesbury's project engineer, before the Southern California Section of the American Rocket Society.

HTV Applications

Initial application of the HTV has been as a research tool. Areas in the field of hypersonic research which can be probed with the HTV include:

- Effect of Reynolds number on heat transfer coefficient with particular emphasis on determination of transition from laminar to turbulent flow. Special measurements such as under-particle appear possible for the application, Amesbury says.

- Relation of surface roughness, pressure gradient (nose shape), distribution, and skin friction to temperature rise to heat transfer coefficient.

- Studies of hypersonic boundary layer, including investigation of shock and boundary layer interactions and their effect on transition from laminar to turbulent flow.

- Upper atmosphere studies. Instrumented packages can be ejected at high altitudes and parachuted to ground. Examples of this type of research, Ames-

bury reports, is the investigation of the validity of artificial satellites produced by firing shaped charges in the case of the HTV.

- High temperature materials in conjunction with tests which can be simulated are higher than those experienced in rocket motors, Amesbury says, and dynamic pressures exceeding 50,000 lb./sq. ft. can be achieved in flight. Many types of materials can be studied in a single flight of the vehicle.

Developmental Uses

As a developmental test device, the HTV could be used to test:

- Special high velocity phenomena at other high speeds.

- Transmission properties of various materials under hypersonic conditions.
- Tracking aids such as laser radar, precision, or sighting changes.

In addition, the HTV could serve as a radar target in the tracking of high speed objects. Corner reflectors or shall could be ejected at extremely high altitudes for testing radar detection equipment.

None one of the HTV is made of a Páramo nose shell and pure metal outer shell, with a 4-in. layer of aluminum lining between the two for resistance. Maximum diameter of the cone is limited to approximately 7 in. To allow for various size investigations,



FINAL PREPARATIONS are made for HTV launching at Holloman. Rifed and straight launchers are used. Control line supplement rifling.

6,800 mph. Design Goal

the motor shell can be stored in three-week from its 600 diameter. It is attached at its forward end to the motor shell and is free to expand inside and outside at its end. Thermocouple wires are suspended in the middle of the motor outer shell and conducted through the Páramo nose shell to the recording equipment located in the base of the nose cone.

Amesbury is conducting design studies on various nose cone configurations including those fabricated from thick-wall glass ducts laminated and meeting and from high conductivity materials. Under construction are light weight nose cones, incorporating fiber-reinforced plastic water recovery.

Time Intervals

Flight data are obtained as a small magnetic tape recorder carried in the HTV's nose. Secured to the forward bulkhead the reel records from eight channels. It weighs about 2 lb. and is contained in a shock-resistant steel case weighing 3 lb. A minimum vacuum is secured to the base of the steel case and will accompany the recorder if it breaks away from the rest of the vehicle. The reference source is directed after the light in centimeter circuit in search of a light signal or loss.

A time base oscillator is normally an integral part of the recording system

and makes exposure one of one of the eight channels. Time intervals as small as one millisecond are easily reached, and accumulated time may be read with an accuracy of 0.1%.

If more channels are required, any or all of the remaining seven channels may be shared by means of a common timing switch which can be driven by the same motor as the tape transport. In this way, Amesbury reports, it is technically feasible to use as many as 15 reference sensors with a recording rate of ten times each per second. It is also possible to obtain a larger recording rate consisting simply of two standard eight channel units placed side by side in series. In this way 14 channels of continuous light data and two time base channels may be secured.

Mechanical drive for the tape transport system is a small permanent magnet type dc motor. This is coupled to the tape transport system in a three-stage rubber belt and pulley reduction system. Functional reliability of the tape transport and the mechanism of the whole has been determined under actual accelerations of 500G's and at angular velocities of 250 and /sec.

Sufficient motor power for an eight-minute flight is supplied by a rechargeable silver-zinc type battery pack consisting of eight standard units. Tests indicate

that these cells are practically unaffected under environmental flight loads.

Aluminum connector plates are used to attach the interconnected nose cone to the HTV's second stage and to join the second stage to the first stage.

Motor Bending

Rocket motors are loaded together with high strength epoxy resin, and are bonded to the motor case. Fine stage fins are constructed of phenolic resin-impregnated OHS in glass cloth laminate stabilized with a plastic resin case material.

Area of each of the second stage fins is about half that of the area of each first stage fin. Triangular butt-jointing framework of each second stage fin consists of a molded glass cloth laminate leading edge, aluminum spar trailing edge, and reinforced aluminum base bonded to the rocket motor shell. Bonded to these framework are first stage of glass cloth laminate molded under high pressure. Spaced within the fin is filled with perforated balsa wood. The dual-wedge shape used for the second stage fins can be used to house components, or small cones, fins, lenses, and antennas.

After the data gathering portion of the flight, second stage fins are blown off to decelerate the vehicle, which then falls relatively slowly because of its high drag-to-weight effect. Impact speed is then kept to approximately 70 mph enabling the tape to be recovered



NOSE CONE section shows installation of reaction tape recorder. Unit is secured to forward bulkhead and weighs 2 lb. Shock resistant steel case weighs 3 lb.

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and the magnetic compass to be aligned in suitable condition most of the time.

The launcher is designed to facilitate transportation, and is easily adaptable for permanent installation on air ships, boats, etc. The vehicle is slid into the launching rack while the launcher is in a horizontal position. The launcher is then elevated to the angle desired for firing.

Both rifled and straight-rail launchers have been used successfully in MTV flight tests. For very high altitude tests in which low temperatures are expected, the rifled launcher is desirable. The rifling provides an initial spin rate of a few revolutions per second to reduce dispersion caused by twist or fin misalignment. The fins are carried to transonic spin throughout the vehicle's boost period. For specific applications where much spin is not desirable or in which short trajectories are expected, straight launching rails can be used.

Lockheed Acquires Missile Test Site

Sunnyvale, Calif.—Development testing and research on new and advanced missile systems and components will be carried out by Lockheed Martin Southern division at a new 400-acre Santa Cruz mountain site.

The facility will be used to evaluate fuel and engine operation of advanced missiles and for the development and static testing of control and sub-system elements to be used with new liquid and solid propelled rocket engines. Also to be evaluated are electronic and chemical experiments and instrumentation.

The site, now being acquired, is in a remote Redwood forested section on the central side of the mountain about 15 mi. from Santa Cruz, Calif. It was carefully chosen so that recreation and farm activities would not cause pollution control, according to L. Eugene Rusek, Lockheed vice president and Missile Division general manager.

The division already has invested \$19 million in facilities in northern California and anticipates an investment of about \$10 million by the end of 1957. Facilities already built and underway at the division's Palo Alto and Sunnyvale sites have a total of more than 390,000 sq. ft. of floor space. The includes 160,000 sq. ft. of research laboratories space in Stanford University's industrial park, and 146,000 sq. ft. of administrative, engineering and manufacturing space at a Sunnyvale, Calif., site adjacent to Moffett Field.

The new division now has 1,000 employees, engineers, technicians, and administrative personnel. It is located at what is the Ray area and about 6,000 ft. from the Van Ness, Calif., plant.



Unusual aerodynamic design of the F-104A Starfighter gives this slim, razor-winged streak of fighter power the greatest combination of speed and flying performance ever built into a combat airplane. The high tail is a significant contribution to precision control... just as Camloc's 4002 Series quarter-turn fasteners on the F-104A's access panels are a significant contribution to security in flight and speed of maintenance... Camloc quarter-turn fasteners open fast, close fast, hold fast!



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PUMP PRIMERS

High mechanical and volumetric efficiencies from GEROTOR aircraft pumps

The design of Gerotor pump combines a number of valuable attributes in aircraft engines, among which are exceptional mechanical and volumetric efficiencies.

The Gerotor is basically a form of internal gear pump. It has only two moving parts — an inner-rotated element which meshes with an outer-rotated element. The inner has one less tooth than the outer and this "meshing mesh" provides a chamber to serve fluid from the intake to discharge port. (See Figure 1.)

Both Gerotor elements turn at the same direction — and either one may be driven. The difference in number of teeth results in a slow relative rotation between the Gerotor as at their faces, gradually opening the chamber as it passes the intake port, allowing fluid to enter, slowly closing as it passes the discharge port, forcing the fluid out. The resultant displacement of the chamber, the resultant continuous contact of each tooth, the interlocking teeth with the outer, provide high output, high pressure and high volumetric efficiency.

The rate of change of the tooth diameter is at a maximum halfway across the ports, at a minimum at the moment of change-over from one port to the other and takes a continuity in between. Almost no change in tooth depth or there are no violent pressure changes. This is particularly valuable at high altitudes where rapid pressure changes and excessive turbulence engenders fatigue and lowered efficiency in other types of pumps.

With only two moving parts, with close relative motion between them, a single shaft and closely balanced clearance, mechanical efficiency remains high over a large service life.

Turbulent flow — is avoidable and wear is negligible in service. Write:

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Proposed Plastic Sub-Satellites

Inflatable plastic sub-satellites have been proposed as a method of recovering the main satellite at part of this information gathering task during the International Geophysical Year (NY Dec 24, p. 31). William J. O'Brien, Jr., research research scientist at the National Advisory Committee for Aeronautics Langley Aeronautical Laboratory (NY), proposed the plan in the committee. He holds one of the collapsed aluminum coated sub-satellites, and one is inflated to its 20 in. diameter at his left. These sub-satellites, which weigh less than a quarter pound, would be carried with main satellites and later they would be inflated automatically in space below.

Cornell Plans Building Program

Cornell Aeronautical Laboratory will spend about \$3,000,000 next year in expansion of its research facilities.

Dr. C. Ross, Laboratory director, said that the eight portions of the 1957 building program will be expansion of the laboratory's hypersonic and high speed research facilities for aircraft and its related dynamics research for non-aircraft program.

Looking toward the future, Ross said that Cornell is working on contracts involving the development of new and advanced weapons systems. He indicated

that the new work is a logical result of the laboratory's successful completion in 1956 of the development of the Laticone guided missile.

Present yearly value of the laboratory's research work totals \$13-\$15 million, Ross said. Most of this work is performed for the armed forces, but Ross said that non-defense, industrial research work in 1956 totaled \$1 million for the first time.

Besides conducting investigations, Cornell is using its flight test dynamics techniques in studying automobile acci-

Mark of a New and Deadly Guided Missile



"Sidewinder" is the Navy's newest air-to-air guided missile. Flight tests have proved the missile to be as vicious as the desert snake, made for which it was named.

In brilliant performance against airborne targets at China Lake, "Sidewinder", Navy's new air-to-air guided missile, has captured the attention of the entire missile industry.

Simple in operation, small and light enough to be carried in quantity by lightweight fighters, "Sidewinder" can be fired singly or in salvo. It requires no complex launching system or special pilot training, and it maneuvers deftly at supersonic speeds. The missile displays extremely high single-shot accuracy — and even more important, it can be launched

well beyond reach of the target aircraft's defense.

"Sidewinder" was developed by the Naval Ordnance Test Station of the Navy Bureau of Ordnance at China Lake, California. Philco assisted NOTS in the research and development program, and performed the subsequent engineering required for manufacture of the missile. "Sidewinder" is now in full production at the Philco Government and Industrial Division.

Philco is proud to have made this important contribution to the development of more effective electronic systems for our national defense.

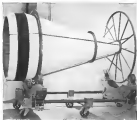
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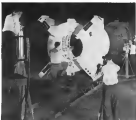


COMPLETED REDSTONE moves down Chrysler Corp.'s Detroit production line on portable rail truck. Missile is 6 1/2 in. in diameter, 93 ft. long. Four main sections are welded, guidance and control, electrical, liquid oxygen, hydrogen peroxide steam source tank, rocket motor.

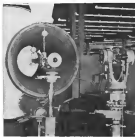
Redstone Assembly Mends Four Sections



ROCKET ENGINE for Redstone, in production line Army Ordnance, runs on special duty. Chamber has found it important to keep a parts polygon check on all units as they go down assembly line in order to achieve best reliability for the crucial ballistic missile.



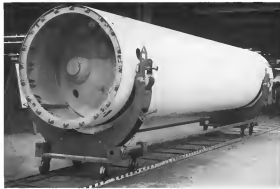
ROCKET ENGINE lowering is critically aligned prior to being joined to tank section. The four radial partitions around the exhaust nozzle aperture house the structure for the graphite plates which help control the nozzle by deflecting the exhaust exhaust.



ROCKET ENGINE (upper left) is aligned in a fixture before it is placed in housing. (Kaiser-Engine Division, North American Aviation, leads the rocket motor). For the critical portion of engine and fueling, Chrysler first aligns the fixture containing the base for mounting sections so that the line of sight is perpendicular to, and intersects with, the center of the mounting base. After the engine is mounted in the fixture, a reference is placed in the exhaust nozzle and aligned so that it is on the line of sight. The alignment of the throat and exit locations are related to measure



the exit-out of the nozzle with respect to the line of sight. The mounting base ring in the fixture is then deflected and used to drill the mounting holes in the housing. By making the hole on both the engine and the housing piece at a place which is precisely parallel to the nozzle center, complete interchangeability is achieved. Length of cable assemblies is indicated in photograph at upper right. Tank section (below) is along on two main conveyor type belts mounted on duty. Belts can be instantly switched to rotate the section for making both holes.



AERONAUTICAL ENGINEERING

Control Influences YC-134 Flow Change

Question on

By Russell Hawley

Trenton, N. J.—Control problems reported from the failure of one boundary layer control engine on the dual engine for the YC-134 result in a single engine for the YC-134A, scheduled to fly next spring.

Steadfast engineers believe that an overstressed lift and drag with BLC on only one wing demands too much speed from the pilot in shutting down the good system. They also believe that control forces are too heavy in the period before the good system is completely stopped.

However, early tests that the airplane would be immediately uncontrollable have failed to materialize in tests at Wright Air Development Center using a BLC equipped C-125. Airplane action and the control control suffered in the dropped airplane gave the pilot a brief instant in which to test of the operating BLC as pump.

Dual System

The dual system on the YC-134 is powered by two 400 cwhp. Combsen-built Apres 2 turboprops located in transverse positions in the wings. Boundary layer is activated over the full span of the trailing edge. Flow over the inboard flap is activated by section and flow over the outboard flap and aileron is activated by elevator pressure jets.

As for the system is flow through the flap gaps in the inboard flap are holes. Inlets are located in the wing trailing edge and require a specially designed flap gap. Air and exhaust gases from the turboprop are channelled outboard by large ducts and blown over the outboard flap sections and the aileron which can be dropped 40 deg to serve as flap.

Steadfast studies indicate that ailerons cannot be dropped more than this and still provide good lateral control. Movement deflection of the flap are none is 60 deg.

Flow rate at maximum power is about 600 cu ft/sec. This figure is modulated in some extent by changes in inlet and outlet area when the deflection angle of the trailing edge surfaces is changed.

Turboprops have variable area inlets to provide an independent control of flow rate.

Heating downstream of the turbine has not been much of a problem.

because of the low proportion of exhaust products in heated air and because of the low compression ratio in the pressure ducts.

Surface and structure temperatures do not rise more than 1500 above ambient.

To allow for this, a small part of the outboard trailing edge structure is made of stainless steel. Experiments gave rise to the idea of inboard and outboard flap sections to keep stress levels down.

Single System

The single BLC system of the A model uses section activation of the boundary layer from tip to tip. In full-scale wind-tunnel tests that has proved to be more efficient than the standard of the volume of air which must be moved to provide an equal amount in lift.

Both systems cut loading and takeoff runs by about 40% and approximately double the coefficient of lift, but the

single system only handles about 150 cu ft/sec. This has made it possible to take the duct out of the wing and run them through the aileron and flap sections.

The ailerons are mounted on large diameter flap joints which let air pass from section to section. Upper leading edges of the movable ailerons have perforated or porous segments through which the system air can be pulled flow down over the wing.

One of the advantages of ducting inboard air through the movable ailerons is that reduced fuel usage space is more than doubled. With ducts and ailerons in the wing the only internal space available for fuel is in the aileron.

Prove for the single system is a Westinghouse J48 turbojet mounted at the outer and extending over the entire cargo door. This arrangement is more expensive in terms of weight than the dual system but Steadfast believes that the advantages of the single system more than offset this. Both dual and

single systems draw fuel from the thrust engine tanks.

When the equipment is available Steadfast hopes to replace the J48 with either one or two turbofans. These would cut the weight penalty involved in designing the aft fuselage section to withstand the heat of turbojet exhaust. Two engines drawing air from both wings would increase stability of the boundary layer control.

Stretched Version

Both the YC-134 and the YC-134A are stretched, fuselage variations of the Steadfast design, Fairchild-built C-123. Though its bell is engineered for subsonic operation, the YC-134 version is intended for use only on land and snow. Its half is not solid and it has no tip floats. There is not enough propeller clearance either for an operation. The thrust line of the A model is about 30 in. higher than that of the basic airplane.

Both models use Wright R3500



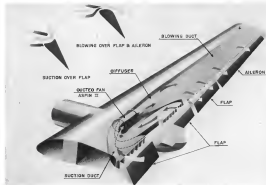
EXTRA vertical fin on YC-134 are needed for engine-out stability with larger engines.



MAIN gear is selected by shifting glideshaft control with shock absorber in legs.



ROCKER arm fails to latch against wheel loads by diving tailfinned wheel down.



BOUNDARY layer of YC-134 is activated by suction through gap of inboard flap sections and suction of air and turboprop combustion products over outboard flap and dropped aileron. First of combustion and compression is slight, internal flow space localized.

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turbine-combustor engines. The main vertical fin, which is identical to that of the lower powered G-123, comes up with the greater dimensions of thrust created by the failure of one of the bigger engines. This was corrected by adding small fins and saddles at the stabilizer tips.

The Poseidon usually transport can split downed something new in the way of landing gear and both the size and the shape of the new Strakoff replace incorporate innovations.

Landing Loads

The Poseidon also extended to bear landing and takeoff loads on snow and water on most two stage shock absorbers. Rates of pressure movement to similar movement increases sharply in wet states. At that point a shock absorber on the piston barrel picks up the cylinder packing gland and comes it along as no extra low square inches of piston face. Its effort is to make the shock absorber in the last part of the stroke.

This is especially valuable with the narrow track Poseidon landing gear, which does not provide much stability in a wet state. If one wing drops, the shock absorber on that side will be forced more than the other and when the second stage is pulled up it will tend to roll the airplane level.

The wheeled wing landing gear far as on dry land has two tandem mounted shock absorbers into the fuselage on each side. Each wheel has a separate leg and shock absorber.

The problem of separating the load as fire and air loads in a tandem configuration is solved by joining the legs to the fuselage through a single rocker arm. As the load is increased on one wheel and leg, the rocker arm draws the other wheel down to pick up half the load. The pivots of the wheel from during onto the front wheels when loads are applied and keeps the landing effect on the rear wheels at a high level. It also loads which rapidly in high angle of attack attack landings.

Flexible Structure

Severe shoring of the truss wheels in low turn do not seem to be a problem. The structure, however, intended to prevent lateral movement is flexible enough to allow the wheels to go in and out and conform to the turning circle.

The YC-114 has been tested through a 190 deg. turn well within the width of a runway. The nose had an involved 60 deg. The shock absorber cylinder and the rotation cylinder of the main landing gear are carried within the leg. The nosewheel has the same diameter as the main wheels to increase its ability to ride over bumps. The

YC-114 Specifications

WING

Total wing area 1,215 sq. ft.
Wing span 112 ft.
Height 34 ft. 3.5 in.
Length 82 ft. 3 in.

POWER PLANT

Two Wright R3310 turbo-compound
Power-normal rated
2,680 hp. at sea level
Power-take-off 3,380 hp. at sea level
Propeller-two two-bladed Aerojet products

WEIGHT

Gross 66,600 lb.
Payload 25,000 lb.
Weight empty 41,600 lb.

MISCELLANEOUS

Ward speed 100 to 160
Woodfuel 120 to 160

compressor load bearing leg of the nose wheel is hinged at the top to allow it to swing at wider longitudinal loads.

A mid fuselage member is hinged to the fuselage well forward of the side. This hinge is the center of rotation for fore and aft and vertical movement of the wheel. Because of this design the nosewheel can ride over bumps higher than the side.

Low Level Supersonic Gust Effects Tested

First phase of Project Skiff, a study of gust effects on low flying supersonic aircraft, has been completed by Northrop Aircraft Corp. under a USAF contract for a two-phase flight test program.

Objectives of the project are to:

- Evaluate gust load factors for design of supersonic class support aircraft.
- Determine accuracy and frequency of gusts in various terrain and weather conditions.
- Record geophysical and physiological effects of gusts on test crews.
- Obtain data to be used in design of a terrain clearance indicator for jet aircraft.

Hundreds of hours of data collection must be done before final phase results will be understandable. The data were obtained on over 70 low level flights near Edwards AFB. Aerojet flight duration was 14 min. In each flight more than 25,000 data readings were taken. The 250 lb. of test flight instrumentation in Phase 2 will be placed on the basis of Phase 1 results. Shock up-



صناعة بيفة كدرج وكحرق

er-Rammah's self-moving egg

Join two flat pans: fill with an incendiary mixture; add a fuel; propel by two large rockets. In A.D. 1280, Arabie's Hassan er-Rammah, genius centuries ahead, proposed this avoid in his "The Book of Fighting on Horseback and with War Engines."

Today, rocket-powered ordnance is foremost in American defense... and Aerojet-General Corporation is foremost in rocket power. Aerojet's solid-propellant rockets are used on the Sparrow and Regulus and on the newest, most advanced American missiles.



We invite you—the engineer, the scientist—to participate at Aerojet in the creation of tomorrow's missiles from yesterday's dreams.



Here is the pilot protection for wiring assemblies requiring a high degree of environmental resistance without the use of metal conductors.

Scintill, equipment developed by the Bendix Division of Bendix's, is a two-purpose thermoplastic material designed to protect and seal wiring assemblies from every operational hazard.

By the combination of plasticizers, stabilizers, pigments and fillers, Scintill has been formulated to meet the requirements of many adverse conditions.

For example, one usage may require low-temperature flexibility, while another is restricted primarily with a high temperature condition, and still other applications may require fuel and acid resistance—or perhaps a combination of all of these characteristics is the desired result.

That is why Scintill is virtually a miracle material, for it can be "tailored" to meet a wide range of requirements, and at the same time, maintain the weight of the finished product.

Scintill can be provided in a variety of solid colors, and can be tinted to provide positive identification. Many electrical connector plug models are available, as well as the T's, Y's and variable models necessary to provide reliable assemblies of any kind or purpose.

Detailed information and data on Scintill available on request.

Circle 100

Can be tailored to meet individual needs and purposes



Proven to seal in such special fields as underwater devices, ground radar equipment, missile rocket wiring.

BENDIX DIVISION OF BENDIX AVIATION CORPORATION
200 WEST 10TH AVENUE, NEW YORK



possible to get load protection is situated rather than functional.

Standard all-weather electronic equipment, with fuel tank and radar oil service packages were removed to make space for instrumentation. Manometer ports and flow direction vanes (see photo) are mounted in a way known to pick up flow changes for correlation with accelerations and stream measured elsewhere in the engine. High speed sensor systems record the heating taken by the pilot in gusts.



Plastic Cylinders Made at Low Cost

Los Angeles—Machinex designed by Pontiac Aviation Corp. for GPR (guns for radar) process is turning out plastic cylinders shaped at low cost.

The new machine (see photo) with an tubular mold rotating at high speeds produces plastic shapes with no external strength, uniformity and tolerance for structural action (AW Feb 29, 1955 p. 13).

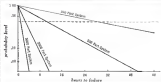
It distributes controlled amounts of resin and chopped fibers simultaneously, turning out parts at large as 10 ft long and 40 in. dia. It accurately forms parts "out of round" as small as .001 in. between major and minor axes and molds integral features into them.

Typical applications for the GPR machine's capabilities are waste and oil engine exhausts, engine mounting flange, aircraft fuel tanks, inside fuel components, electrical mechanisms and various countermeasures. Experimental production on components is underway.



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The fewer the number of components required for any electronic system—the longer the life expectancy of effective performance.

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with the aircraft industry
for nearly 30 years

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For more rotor shafts of jet engines, all ball bearings are designed and constructed to meet individual requirements. The bearing (illustrated) is a "custom bearing" representing both bearing and bearing case dimensions (tolerances, high finishes, and special treatments for maximum performance and maximum reliability.



GUP (GUN) AIRFRAME CONTROL BEARINGS

These bearings offer "fit and capacity for weight and load" in a bearing that is clean in design and balanced in capacity. Their features include a full complement of precision rollers, large filled-to-eyes contact area on both inner and outer rings, and special and precision rollers provide strength in both in case of stress redistribution.

TURBO SERIES COGGE FITTING CONTROL BEARINGS

Especially designed for turbo shaft applications in helicopters, the Turbo Series consists of a matched pair of thin section, angular contact type bearings equipped with helical preloaded thrust washers. All exposed surfaces are finished on special bearings are provided with helical preloading to the latest industry specifications.



LATRA SMALL CASE BEARINGS

Designed for use in turbine engine, turbo pumps and other precision aircraft mechanisms, the extra small size bearings are available in sizes from 1/8 inch diameter to 1/2 inch diameter. They are also available with standard, special or super precision rollers to meet requirements, and they can be fitted with various combinations of seals and shields.

ADVANCED-DESIGN SERIES BOB BEARS

This is the only series of rod and nut bearings with a double ball design providing strength and capacity without excess weight. In this series, there are three sizes of high capacity roller-type ball nuts for precision ground control systems and two sizes of ball bearings and nuts with high-precision finish for accurately spaced control systems.



TORQUE-TUBE TYPE BEARINGS

The TORQUE-TUBE Series was developed specifically for tube applications and provides a bearing which is strong in weight is essential without any reduction in bearing capacity. This self-aligning feature plus the bearing's parallel shaft feature of application. The Torque-Tube Series is selected by machine tool and engine makers. All exposed rollers are mounted on a precision ground.

ROD END BEARINGS

Positive protection against environmental and vibration of corrosion and the extraordinary features of the rod end series, torque tube type roller. These bearings or make possible the use of deeply tapered roller and weight saving bearings. Models are also available, double-roller type. All exposed rollers are mounted on a precision ground. The series is continuously increasing with the 1952 series.



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AIRCRAFT BEARINGS

FAFNIR, at the turning points in aircraft design



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Pressure Suit at 198,770 Ft.

An Research and Development Company's new emergency bailout suit worn in two versions—MC-17 for bomber crews and MC-18 with built-in emergency suit for fighter pilots. Biggest improvement is that pilots wearing the suit do not have to leave to rescue themselves as they did with the T-1 suit. May. AeroM 1. Back in shows wearing the MC-18 suit in his suit altitude record of 198,770 ft. in an altitude test chamber at Wright Air Development Center, Ohio. (AW Dec 24, p. 30)

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Proactive use of atomic energy has become a reality thanks to the development of the first nuclear reactor designed for positive industrial research by Atomic International, a division of North American Aviation.

Research World's unprecedented Atomic International in this important achievement and is proud to be a subcontractor to such a forward-looking concern.

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Lockheed Plans Test Bed, Electra Assembly

Lockheed Aircraft Corp., beginning assembly operations this month for its maiden single Electra turboprop, will modify a Super Constellation to serve as a four engine test bed for the Allison 501D13 engines that will power the aircraft.

The four engines, which will be equipped with AvcoProducts 926 four bladed propellers, are commercial versions of the Allison T36 that power the C-119 Hercules. The engine develops 1710 chp.

Lockheed's goal is to pile up over 1,000 flight hours on the engine-propeller combinations under hot and cold weather extremes at altitudes up to 30,000 ft.

Flights of the Constellation test bed will begin in July, six months before the Electra is scheduled to take to the air. The "dead start" plan is part of the Lockheed/Allison program to log 500,000 engine hours before the first Electra delivery.

Lockheed reports "excellent results" on the first phase of the program during which a single T36 engine was modified to resemble the commercial version and flown in a Constellation test bed. This airplane now is being



Helicopters Supply Mid-Canada Line

Sikorsky HO4S helicopters of Royal Canadian Navy Antares Squadron 315-50 take off from a landing base at Kook Lake in Northern Quebec on a supply mission for units on the mid-Canada winter line at Labrador. Six Navy helicopters were among 40 supplied by the RCNCF, USARP and private operators to help complete the mission in the first of this year. Helicopters filled in the dead zone areas which had been unable to land on their own skids. The Navy helicopters have averaged 5 1/2 h in the air. On one recent 10-day mission, an HO4S carried steel rigging and cable technicians to the log, carried 400 lb of fuel, plus living gear, a ton of food and diesel fuel and other cargo in short trips from a helicopter landing area to the station. Total air time was 52 hr and the mileage was 1,795.

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The Lear LC Attitude Compensating Compass has:

CTG—completely compensated system—for longer life, elimination of tube wear/leakage, and significant reduction in weight, space, and power required.

DOS—direct output system—right on the motor frame of gyros to eliminate backlash and signal inaccuracy due to servo gear train.

OTP—only two package system—for ease of installation and maintenance, greater compactness, and reduction of weight because of minimum interconnecting cabling.

ILC—internal helix compensation—for accurate performance at any point on the earth's surface.

PCS—granted circuit system—for greater dependability and reduction in weight and cost.

ASG—all steel gyro—extreme design; reduces vibration in gyro due to temperature changes; provides free drift of less than 4 degrees an hour.

DMO—dual mode operation—providing a "slow" mode for areas of normal magnetic flux, and a "fast" mode for areas of magnetic disturbance.

LJC—lowest in cost—considerably less than any other compass of its type. Yet the Lear LC exceeds every performance specification laid down by the Bureau of Aeronautics, U.S. Navy, for the MA-1 type of compass.

LEAR LC COMPASS

Gyro-stabilized compass system providing accurate directional heading and autopilot control for aircraft under all conditions anywhere in the globe.



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TO THE
COMPASS





Sightseeing at 700 m.p.h.—NAVY STYLE

A jet-propelled "cannon shell" pays off—at a Navy's eye's—looks to how under enemy radar—seems to pump length—drops its flame and turns intelligible pictures. Clear pictures are obtained, despite the extreme speed, because Librascope photo-transmission equipment is part of the mission. But getting the picture is only part of the job. The data must be correctly integrated back at home base. Here Librascope photo-transmission equipment assures final success of the mission.

Librascope is noted for important developments in military aviation, including pilot and navigator viewfinders, periscopes, fire control systems and radarscope computers. This reputation has been built on advanced engineering skills in optical, electronic, mechanical and analog/digital computer technology. If you are concerned with military or commercial projects—specialized engineering, personnel and completed facilities are available to you at Librascope for research development and production.

ANNOUNCEMENT... Learn about Librascope's new versatile "Project Development Team" write Don Walker, Chief Engineer



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fitted with a single S00D01, and its first flight is scheduled for next month.

To prepare for assembly Lockheed has negotiated over 2,500 purchase commitments totaling more than \$100 million.

Material worth more than \$2.5 million has already been delivered.

Initial assembly operations involve wing skins, wing beams and trailing edge assemblies. Main wing box beams, access and fuselage structures will follow in February.

Production moves from the main plant facilities Lockheed, Bakersfield tool assemblies; Maxwell, small sub-assemblies; Buick Aircraft, San Diego, power packages; Textron Aircraft, Dallas, wingtips and wing trailing and leading edges; McDonnell, Burbank, main landing gear assemblies. Final assembly is scheduled for August.

The first Electra will go to transport wing flight test in December and will fly by June, 1958.

Other Electra developments:

- **Design Consultant** Henry Deeken will show Electra customers how cabin will look by using a 1/48-scale model of full sections, complete with respect, seats, windows, doors, and interior fittings in various colors and texture arrangements.
- **Passenger walking down the aisle** will be kept free of clutter by a network of stairs in the carpet underbelly to ground static electricity.
- **New nose gear** that can be disassembled for ground handling so that it turns freely as it rolls will be used. When towing line is removed, the wheel returns to normal.

Coating Provides Fog-Free Surface

Berktek, Galt-Serrano, an electrolytically conductive coating developed by Serrano Corp. for coating surfaces of aircraft transparent instruments, is now being applied to prototype versions of canopy plastic side panels for the Convair F-106A and the Air Force's new MA-1A private jetliner tests. Purpose of the transparent coating is to provide a fog-free surface with a minimum of optical distortion.

If the Berktek meets for the F-106A successfully, same application may, now underway at Convair, San Diego, they are projected for the two-seat F-106B trainer and the side test TF-102 trainer.

Serrano claims for the MA-1A private jetliner have been applied to Wright Air Development Corp's Air Medical Section under a research and development contract and are now under test there. The jetliner was designed by Bell Jet Scientific Instru-

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The Answer to Jet Age Accessory Power Problems

The need for hydraulic, electric, and mechanical power multiplies with every major advance in aircraft performance. The high speeds of today's jet demand more hydraulic power for turbochargers, fuel control, landing gear, etc. Widespread use of electronic equipment has greatly increased electrical requirements. The increasing surface level of high-performance planes really compounds the problem. Not only must today's aircraft have an accessory system that can meet increased power requirements, it must do so in space, but he must be sure it can operate in hot environments.

Some accessory equipment, such as is now in use, is greatly affected by heat. Diesel drives attached to the engine, hydraulic motor drives, and gas turbine power units (GTU's)—are extremely vulnerable to high ambient temperatures. In addition, they generate so much heat in operation that a method of removing the heat must be employed. Other limitations, such as inadequate lubricants, heat pumps, or the expense of extremely high-temperature fuels may preclude the use of these methods if thermodynamic requirements continue to grow.

Heat Problem Changes The Design Picture

The heat problem has become so complex that top engineers now realize the importance of separating the accessory power in part of the powerplant and wing/disk design effort. In the absence of adequate access to vented hot air, temperatures, designers now see the advantage of separating thermally-insulating equipment and conductors in part of the air frame design in order to avoid surface areas to be used as thermal components.

As a suitable, convenient source of compressed air, the jet engine provides the way to solve many of these problems. An extension from its compressor, can be ducted to nearly any part of the aircraft frame for purposes of cooling, boundary layer control, and driving fans. The weight of this equipment is comparable to the air mass. Since access to compressed air for the engine is available to the air mass, access to compressed air for the engine is available to the air mass.

Air-turbine Drives Permit Integrated System

This trend calls new importance on the

size and selection of accessory systems. With a compressed air supply closely integrated with the surface, the use of turbine drives permits more efficient integration of the reference and the accessory system. In many installations, the same air used in the engine exhaust system can be used to spin small turbine wheels mounted on shafts. These, in turn, drive generators, hydraulic pumps, fuel pumps, closed-circuit cooling equipment, radio and navigation, and other accessories.



Turbine Run on Air Bled From Compressor

Operating on this simple principle, air-turbine drives can efficiently perform nearly every accessory function aboard jet or turboprop aircraft.

Simpler Construction—Greater Reliability

Jet turbine drives are inherently more reliable because they require fewer moving parts than any other method of generating power. Only one efficient, rotating turbine wheel and shaft is required to drive the plane's electrical and hydraulic systems. Completely maintenance-free operation is obtained by an integral control system. Whenever a load demand occurs, a system of regulating and actuating drives changes the turbine output to meet the power requirements.

Reliability of an air-turbine drive system is achieved by great simplification of the plane's air supply duct. Through this method, all units on the aircraft are supplied from one air source, the engine. In early engine models, failure of one or more engines would not mean loss of accessory power as long as one engine remained to supply bleed air.

The operating history of units now in use, such as those on Boeing's 737, shows that the simple, comparatively frictionless construction of air-turbine drives can greatly reduce wear and result in longer, more dependable service. In addition, they permit more efficient packaging of generators of required, and with a ground source of air, can be tested without leaving the main engine.

Install Where Power Is Needed



Air-turbine Permit Permanent Location

Air turbine drives and the accessories they operate may be located anywhere in the plane where power is needed. In the 737, for example, ten hydraulic actuators are distributed at both wings and the fuselage—close to the point where power is needed. Such versatile functional location is possible because air is relatively easy to transport and because it requires no return system.

Located away from the engine, these drives can contribute to a cleaner turbine design by routing engine bleed air and reducing frontal area. Also by installing them close to the "consumers," short hydraulic and electric transmission lines can be used. This results in a lighter and less complex system.

These advantages permit a significant increase in aircraft speed and range, at payload.

Forecast for the Future

Single and Nuclear Powerplants—It is expected that air turbine drives will play an increasingly important role in the future. In aircraft utilizing a turbo prop,

the largest portion of the engine may be shut down during the emergency portion of flight. This would mean that no mechanical power would be available from the main powerplant for accessory operation. A separate system, however, could provide accessory power under such conditions.

Another indication that more accessory power will be needed in the future exists in the increased requirements for nuclear-powered aircraft. Large amounts of power may be needed for specialized functions associated with the reaction. Basically, nuclear air turbine drives, fitted with an auxiliary power unit, could supply a large block of power sufficient to provide an aircraft in vast flight to take.

G.E. Pioneered Air-turbine Drives

General Electric's Aircraft Auxiliary Turbine Department in Lynn, Mass. is one of the nation's prime suppliers of turbine drives for aircraft accessory power.

Drawing on G.E.'s vast experience in producing industrial and aircraft gas turbines, the department has consistently advanced the state of turbine-drive equipment design.

Just as General Electric pioneered the "radical" aircraft turbopropeller in 1918, through the Aircraft Auxiliary Turbine Department, it is now building turbine drive equipment to solve the accessory power problems of the jet age.

G-E Turbopumps and Turbine Drives help supply oil lubricant and electric power on the Boeing 737. Scavenger pumps, first applied in history to use pneumatic-drive power equipment for operating in engine accessory spaces.

Driven by air bled from the jet engines, G-E turbopumps and alternators directly supply 8 gpm at 2600 psi and 10 kw at 100 cps, respectively. They give the hot-bearing power for operating steering, control surfaces, landing gear, fuel-burners, spoilers, radio, lighting, and accessories.

G-E Fuel Turbopump

This turbo-driven, air-driven unit provides 60 gallons of super-lean fuel per minute, giving North American's F-105 its complete fuel control for all engine burner operations. General Electric's F-105 fuel turbine drives, the Allthorpe Fuel Pump is lightweight and compact and can be functionally located in the aircraft.

G-E Turbosensors

Another application of the versatile line is in the self-contained turbo-sensor (used on the Martin B-57) which draws a jet engine air flow less than 30 inches.

It is powered by hot gas coming from the combustion of an air-cylindrical solid-propellant cartridge. Turbosensors estimate the need for ground power start-up needs, minimize engine problems, and increase jet thrust availability.



G-E Turbopump and Turbine Drive Help Power B-57's Accessory System



G-E Afterburner Turbopump Gives North American F-105 Jet Engine Power Reserve



G-E Fuel Turbine Drive North B-57 Aircraft Engine, G-E Also Makes Fuel/Air Turbine



Advanced Air-turbine Drives Are "In the Works"

General Electric's Aircraft Auxiliary Turbine Department will produce a plant at more than \$15 million, in carrying out an extensive development program on advanced air turbine equipment. Units with extremely high power-to-weight ratios are already in advanced stages of testing. These programs promise powerful answers to accessory power requirements that be ahead.

To find out how G-E air-turbine equipment can help you now in the planning stages, contact your General Electric Aircraft & Defense Industries Sales Office or write for the descriptive literature on the drive you are interested in.

General Electric Co., Switch 3337-4, Schenectady, N. Y.

Please send me the following brochures on the Air-turbine Drives:

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☐ G-E-1000 Hydraulic Turbopump Fuel Jet Aircraft

☐ G-E-1000 Fuel Turbine Drive Fuel Jet Aircraft

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Mechanical Products Announces:

MINIATURE AIRCRAFT CIRCUIT BREAKER

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SAVES WEIGHT! SAVES SPACE!

Meets Military Performance Requirements

Send them higher and farther... with better protected electrical systems. MP-700 Series—the important new development in breakers—is so small you can use many more and still end up with less weight. Give circuits individual protection instead of grouping. Perform in accordance with MIL C-3809 B (ASG). Self-clearing contacts. Industry developed equipment (IDE) approval issued August 31, 1956.



Write for detailed Spec Sheet No. AW-1

MECHANICAL PRODUCTS, INC. • JACKSON, MICHIGAN

ment Co., Solana Beach, Calif.

A Servotac panel also is being tested at Douglas F-106quad Division for an interlocking application on the F4D Sigma. This is an inert panel used in conjunction with the present circuit panel to avoid redundant wiring.

Servotac applications are also being considered for the plastic side panels of pilots' cockpits on the Douglas C-135A, and for the critical transport position of Pacific Aerospace Corp.'s Learjet executive transport.

In the C-135A installation, the coating would be selected to replace the present hot air defogging system. In the Learjet, the coating would be used with an infrared reflector to reduce cabin heating and provide a cooler cockpit. In such an application it is possible to get up to 85% infrared reflection. Servotac's effect of light transmission is not of general interest. WADC's Materials Laboratory is evaluating a similar use for a protective heat reflecting fire fighting helmet visor.

Servotac is applied to polycarbonate plastics and is incorporated in a vinyl laminated construction to protect the coating from abrasion. Servotac supplies a flat plastic laminate compatible with both for connecting to the aircraft power supply. A warning circuit installed on the surface or subjoined in the vinyl automatically controls heat input to the panel. Any burning or melting of the panel is prevented by the plastic laminate to provide a finished part.

The coating may also be applied to glass surfaces, thermocouple, and each side of coating protection for such applications are being developed.

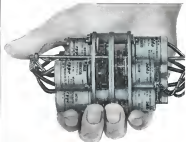
Approximately 70% light transmission is obtained with Servotac. It may be applied in thicknesses of 5 to 20 mils per square inch. It may also be applied with a gradient capability to compensate for non-uniform heat input.

For anti-fogging applications, Servotac normally requires a heat input of one to two watts per square inch, although laboratory tests have indicated that the coating has power-breeding capacity considerable in excess of this. Servotac may thus indicate that entering applications may be possible, although this phase of research has not yet been thoroughly investigated by Stinson.

Ultrasonic Measuring Devices Developed

Los Angeles—Development of two new ultrasonic liquid measuring devices, a level indicator and flowmeter, for marine and aircraft, were received by Dr. W. Wilkerson, Colson Industries,

4 Intercoupled servo loops



weight less than 2 lbs.*



This indicator, part of an Automatic Navigational System, contains 6 synchros, 2 motors and 2 motor generators—all Clifton Sincro 10 units.

These units (and 2 mechanical differentials) are built into 4 independent, intercoupled servo loops. Weight of these 4 loops plus gears and gear plates is less than 2 lbs.

The main reason for the lightness of Clifton synchros, and hence the lightness of systems built around Clifton components, is that no unnecessarily heavy materials are used in their manufacture.

When it is a question of highest accuracy with the least bulk and weight, look to CPPC rotary components.

* If this system had been built with our latest Size 8 synchros, weight would have been brought to about 1 1/2 lbs.

Look to CPPC for Sincro Progress

CLIFTON PRECISION PRODUCTS CO., INC. **cppc** Clifton Heights, Pa.

The New Pastushin Full-Shear Stress Panel Fastener does what a panel fastener should do!

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in quantity!



*Fastens and unfastens a panel
faster and easier than
any other fastener on the market!*

Check these important features:

Full Shear Strength — stud design increases full shear strength 50% in MIL-STD specifications and/or NAS 104-335 close tolerance bolt.

Positive Mechanical Lock — when stud is seated, it's locked! Visual inspection assures safe lock.

Automatic Stud Ejection — when stud is released, it automatically springs opened from the nutcase, allowing panel removal without forcing or prying.

Corrosion Resistant — offers no problem, small radius of stud into nutcase usually allows ventilation and operation on surfaces of too close nut case edges.

Breaks Load Stud Thread — ensures top performance and trouble-free long service life.

Materials and Finishes — critical bearing surfaces are of CM steel, heat treated to rapid operations. Nut parts are cadmium plated, aluminum alloy parts anodized.

*Write for complete information on Pastushin's Full-Shear Stress Panel Fasteners, designed for high strength and simplified assembly of access panels and equipment on modern aircraft.

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LOS ANGELES, CALIFORNIA — BOSTON, MASSACHUSETTS

• absolute positive lock ...
• full shear strength
• automatic spring ejection of
stud ... no prying to free panel
• curved panel is no problem
• only two assemblies (self-
retained) ... stud and retainer
• no special installation tools ...
Phillips head recess

Inc., Metuchen, N. J., at Pennwalt Electronics Associates' ground school environment test systems.

Calhoun's liquid level indicator has been obtained by Douglas Aircraft Co. for evaluation in ground test of the Thor automobile range ballistic missile. In this application the indicator will measure liquid oxygen and JP-4 fuel levels.

The instrument functions independent of temperature by making a non-linear measurement of acoustic speed of sound of the liquid, giving a continuous correction for density. Calibration is performed only initially because it is independent of the liquid being measured.

Measurement is performed through the tank wall and liquid with an ultrasonic pecking system. Rate of pecking is a measure of the liquid height. Pulse goes through the liquid, is reflected from the liquid surface, returns to transducer, and triggers the transmitter.

An independent motion pecking across the tank (fixed distance) corrects for sound velocity, so that by relating both measurements (pecking to the liquid and across the tank cross-section) the absolute height of the liquid is obtained independent of the liquid's acoustic properties.

Calhoun's flowmeter is an ultrasonic beam deflection system which has a built-in correction for acoustic speed of sound so that the output reading is a measure of mass flow and is independent of the acoustic velocity in the liquid.

The cubic meter is located outside the pipe. Ultrasonic beam is projected at an angle across the pipe and is picked up by a deflected crystal transducer. Time of flight gives a change in the angle of the beam and the change is proportional to the flow velocity. The product as calculated output on the pickup transducer. An acoustic sensing system measures acoustic impedance directly across the pipe. In relating the beam deflection output and the impedance measurement the true mass flow is obtained for any liquid being used.

Kidde Gets Contract For F-27 Pneumatics

Pneumatic system responsibility for the Fairchild F-27 Friendship turboprop transport is being handled by Walter Kidde & Co., Belleville, N. J. Its performance will be two Kidde 2-D compressors, each developing 3,500 psi, 7 cubic ft per sec level. The compressors are powered from gear boxes driven by the 1,600-shp Rolls-Royce Dart engine.

The pneumatic system is expected to result in weight saving of 100 lb over comparable installations.

Skyways WITHOUT Runways

A small clearing in the jungle ... an ice flat in the arctic ... a concrete plateau—a crosser deck, a road—these are some of the altitudes of Vercel aircraft.

Free from the restricting dimensions of distant airfields and costly runways, Vercel helicopters have led the way in developing a new kind of mobility. Their modern noise performance has allowed the use of Army field service, Navy duty and of Global Air Force missions ranging from rescue to operational doctrine.

Revolutionary aircraft now taking shape at Vercel will combine helicopter ability to hover, to rise and land vertically, with the performance of current jets. Now, at Vercel, the Skyways-without-runways concept is being taken to its ultimate phase: high speed aircraft capable of vertical takeoff and landing.

Engineer, join Vercel's advanced engineering team!



VERTOL

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How to make your automatic heat-treating and hardening even more automatic ...at no extra cost

FAST, continuous operation is the key to profitable automatic forging, production lines. Especially to high speed heat-treating and hardening operations. They're extremely sensitive to changes in chemical composition and structure of steel used. Interruptions to make tests or adjustments slow production, increase costs, reduce the advantages of automatic operations. This makes the uniformity of the steel you use an even more vital factor. The more uniform the steel, the smoother the production and the greater the potential you can realize from your automatic equipment.

You can get the utmost in uniformity, and automatic operation—at no extra cost—by using Timken® fine alloy steel. Uniformity is consistent from bar to bar, heat to heat, order to order.

We take every extra quality-control step to assure this uniformity. For example, the Timken Company uses a magnetic stress free

method steel to assure equal distribution of alloys, uniform temperature and improved working of the slug. It's the first lamination of its type in the United States.

To further assure uniformity, your order of Timken fine alloy steel is handled individually. We target our conditioning procedures to meet your end use requirements. Each bar is stamped to identify the heat it came from. This insures variations within an order as well as from order to order. And every heat is examined spectrometrically to insure uniform grain size.

To make your automatic heat-treating and hardening operations even more automatic—at no extra cost—always specify Timken fine alloy steel. You'll get money-saving performance and uniform results every time. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio, Cable address, "TIMROSGO".

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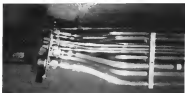
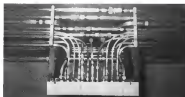
New Jig Is Designed For DC-3 Galleries

Melbourne, Australia—An economical wire jig has been designed and evaluated by engineers of MacRobertson Miller Airlines Ltd., a Western Australian airline operator of Perth Western Australia. The new jig is designed for building and aligning the plumbing gallery of DC-3 aircraft.

The introduction means a big saving in the time taken to install the plumbing gallery. At the same time it allows a much lighter degree of access to the main floor work. Cost of construction of such a jig is extremely low and the use of the jig is expected to result in a standardization of all the DC-3 plumbing galleries at airport terminals.

The chief engineer of MacRobertson Miller Airlines Ltd. said the necessity for developing a fast and easy way plumbing jig for DC-3 galleries was brought about by the excessive discrepancies encountered when using an unworkable line as a template for the complicated job. The gallery contains all the fuel, hydraulic and instrument pipe lines. Top photo (right) shows center wire lines at landing edge connector plate. Bottom view details arrangement at specific end of wing center section.

The plumbing gallery jig provides an



Aircraft's Wire's Who Reports

A cross section of the Wire's Who in the aircraft industry—including Douglas, Alcoa, Ford, Chrysler, General Motors, Republic, Canadian Ltd., Pratt and Whitney among a host of others—is reported to have reduced engine wiring time at much as 60%. This saving is effected by the use of the new Robinson Wire Twister, an improved model of the one that have been service with the army, navy and airlines since 1943. Improvements include the exclusive diagonal jaw design that permits easier access to hard-to-reach areas, and clamps a wire like grip on the way by pulling it into a 90° bend thus delivering added leverage for twisting.

In addition to the greatly increased engine wiring speed, users attest to increased shop safety—fewer skinned knuckles and bruised fingers.

Besides their production line assignments, Robinson Wire Twisters readily adapt to the shop to bench work, on auto and radar equipment, on magnets, carburetors, instruments and sub-assembly work of all kinds.

List price is \$16.50. Write for fully descriptive literature to Ralph C. Robinson, Company, Dept. W, Box 2494, 2516 Crosby Way, North Sacramento 85, California.



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¾ the usual
wiring costs





JETCAL
analyzer

Tests EGT System Accuracy to $\pm 4^{\circ}\text{C}$ at Test Temperature
(Functionally, without removing the engine)

Tests RPM Accuracy to 10 RPM in 10,000 RPM ($\pm 0.1\%$)



Two of the most important factors that affect jet engine life, efficiency, and safe operation are Exhaust Gas Temperature (EGT) and Fuel Air Ratio (FAR). The

The JETCAL is a worldwide use. Used by U.S. Navy and Air Force as well as by major aircraft and engine manufacturers. Write, wire or phone for complete information.

[illegible]

2000 1997-2
 Model 207C1
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 10' Fanco, 21" 70' Fan
 21" Superflow light-
 beam reflector,
 41' Test Drive.

The Australian flag consists of a center RSI base to which eight legs are incident. They enable it to be used for either gallery or plumbing. A series of angle iron bars are mounted on the upper and lower sides of the base in such a manner as they represent the contours of the foliage mountings for the galleries.

Each base is drilled and tapped to take the Adcl clamp attaching bolts in the correct multi-phase positions. Outriggers are fitted to each end and at the center to accommodate the tree connector plates. Drawn connections are fitted for the correct positioning of hole off-sets.

To insert the pg. other yellow can be brought upmost allowing double use of same

When the galler is domesticated and the connector plates and lower portions of the Adol clamps are in position, the replacement boxes must be formed and fitted to the gg. By sliding a bar in the Adol clamps to meet its particular bolt-hole across at the connector plate, alignment can be obtained to very fine limits and the center connections made with accuracy.

As each level of gluing is completed, the next portion of the *Adi* change is fitted until the gully is completed. As the cad connector plates are held in their correct angular position, the coupling nuts can be finally tightened before the gully is installed in the aircraft. Two weeks had elapsed due to the restricted access to the coupling nuts.

The real value of any scientific or professional society meeting lies in the opportunity for discussing some problem with somebody else. The technical papers are secondary.

Instead, the society will provide a number of rooms with soft chairs and good lights, a blackboard and chalk, pads and pencils. These rooms will be staffed by volunteers with customer problems and the talk will be loud and energetic. And more will be accomplished than ever could be by sitting in a dimmed room, while try-



A black and white photograph of a United Air Lines cargo aircraft, a multi-engine propeller plane, viewed from the side. The tail of the plane features the United logo and the text "UNITED AIR LINES".

"From a customer relations standpoint, our ground equipment must look in good as our spools arrive," reports Mr. George Lantz, Union's Chief of Plant Maintenance at Midway Airport in Chicago. "We were jacking out part of that work because we had limited space in our paint shop, but our gear was away from the airport for long stretches at a time. A Binks expense helped us solve both our time and space problems."

New line was saved. Based upon previous experience, Mr. Lantz also demanded the installation of Binks equipment and called on Binks' sales representative to make the sale. "Drive-thru" spray booth and drying area were installed to produce freeway quality, dust-free finishes... quickly dried to a mirror-like hardness. This set-up accommodates the largest tanks or several units of small equipment. A change-controlling electric air supply system was also installed in the shop to replace the air exhausted through the booth and to prevent dust infiltration.

New space was saved. The drying oven was placed on trucks so it could be rolled into the booth for finish drying or storage when not in use. Electrical interlocks prevent accidental simultaneous operation.

Engineering assistance—your own with no charge....over 60 years of experience in the design and manufacture and application of spray painting equipment is ready to serve you. Call your nearest Binks office or write to the address below.

New time was saved...based upon previous experience, Mr. Lantz also commanded the installation of Binks equipment and called in Binks engineers for consultation. A Binks "drive-thru" spray booth and drying oven were installed to produce first-class, dust-free finishes...

How time was saved...based upon previous experience, Mr. Lantz personally commanded the members of Blinks equipment and called in Blinks engineers for consultation. A Blinks "drive-thru" spray booth and drying oven were installed to produce factory quality, dust-free finishes...

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If you work with small instrument type bearings you'll find this new, authoritative publication an extremely valuable and handy source of engineering data arranged in convenient form for practical reference.

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- A helpful survey article "FACTORS TO CONSIDER IN SELECTING SMALL INSTRUMENT BALL BEARINGS."
- A complete, practical presentation of bearing facts:

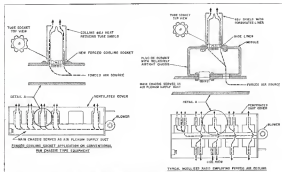
Type of bearing	Dynamics and static loads
Materials	Lubrication
Construction	Rolling and axial play
Inspecting standards	Temperatures
Tolerances	Mounting practice, etc.

- Large, clear illustrations.
- Big, easy-to-follow charts.
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NEW HAMPSHIRE BALL BEARINGS, INC., Peterborough, New Hampshire



SLOTTED tube socket developed by Collins gives efficient forced-air tube cooling with almost no modular type construction.

Socket Slots Pay Tube Cooling Dividend

By Philip J. Klein

Collins Radio, Inc.—Reduction in tube failures, longer useful lives of antenna equipment, availability, ease, result from use of a new type socket for vacuum tubes.

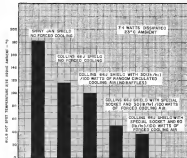
Slots in the tube socket permit forced air to pass between tube and its shield, insulating cooling air circulation without fan action.

Collins Radio Co. developed the socket together with a simple graphical technique for predicting forced air flow rate for individual tubes in use. Air rate dependent. It has not been checked whether Collins or Sylvania, which is looking to manufacture the socket for Collins, will market the device to other vacuum component makers.

Heat Is Duesdy

Significance of the Collins socket is emphasized by recent General Electric tests, under military sponsorship which provided quantitative evidence on the dual effect of temperature on tube life.

For example, type 607B seven triode tubes operated at a bulb temperature



COLLINS tests show sharp reduction in tube temperature with new slotted socket



NEW

"TAPE-ON" SURFACE TEMPERATURE RESISTORS for Temperature Telemetering

- NO HOLES TO DRILL — QUICK AND EASY "TAPE-ON" INSTALLATION
- OUTPUT UP TO 5 VOLTS WITHOUT AMPLIFICATION
- AVAILABLE IN VARIOUS RANGES FROM -500° to $+400^{\circ}$ F.
- RESISTANCE CHANGE OF 100 OHMS OVER SPECIFIED RANGE

Trans-Sonics Type 3371 "Tape-on" Surface Temperature Resistors are precision resistance thermometers with a platinum resistance winding on the sensing element. They may be applied to any surface whose temperature is to be measured. In a constant current circuit, they produce a standard telemetering resistance without amplification. The new Type 1321 "Tape-on" Surface Temperature Resistors may be added to an existing system using other Trans-Sonics temperature transducers without any further circuitry modification. Each resistor is furnished with two 6' long BNC-type coaxial connector leads. Write for Bulletin 1370 to Trans-Sonics, Inc., Dept. T.

*See Technical

SPECIFICATIONS

- Size: $1\frac{1}{2}'' \times \frac{1}{2}''$
Accuracy: $\pm 0.5\%$ of full scale range
Precision: $\pm 0.2\%$ of full scale range
Maximum Continuous Current: 25 ma rms (intermittent over 1 second)
Environmental Operating Conditions:
Vibration: 1" double amplitude, 2 to 20 cps ± 15 ; 20 to 1000 cps
Shock: 100g in any direction, per pulse (per 4.161 of MIL-STD-883C, D) (no additional shock)



As easy to apply
as a thumb print

For Transducers, See Trans-Sonics

Trans-Sonics, Inc.

P. O. BOX 102

LITTLETON, CO. 80120

of 115C suffered only 4% failure after 500 hr operation when the same tube mounted at a temperature of 160C suffered 24% failure over the same period. After 5,000 hr operation, there was only 8% failure of tubes operated at 115C while temperature compared to 60% for those at 160C. After 5,000 hours, the 115C tube failures reached only 15%, compared to 70% for the 160C tubes.

Controlled Cooling

Instead of routine cooling of the entire engine chamber by blowing air through it, Collins kept the air through a plenum duct on the chamber. Cooling air is forced up through duct in the tube socket, around between the tube and its shield, out through the top of the shield and making finally from fan out to the equipment case.

To determine the effectiveness of the cooling technique, Collins ran tests on a number of different configurations using a 42A07 (two triodes) dissipating 74 watts.

When the tube was operated with an air-cooled shield and no forced air cooling, tube bulb temperature rose to 180C; those without temperature (115C). In a third temperature of 301C. At the higher ambient temperatures encountered in engine aircraft, total tube temperature would be pushing 250-300C.

On the basis of its extensive tests, GE concluded that maximum operating temperatures of this type should never operate at total temperatures above 101C, and if long life is desired, maximum total temperature should not exceed roughly 100C.

When Collins suggested the tube using its 661 shield with congealed liner that conducts heat from tube envelope to shield, temperature was reduced from 180C to 116C, a significant but insufficient improvement.

When forced air at a rate of 30 ft./min. with power dissipation was circulated around the tube shield, similar to the cooling technique now employed in many electronic equipment, tube temperature was now lowered only 16C (from 116C to 100C).

But when the same air flow was piped through the new Collins tube socket, tube temperature was now dropped from 116C to a mere 50C, a four-fold improvement over the temperature reduction achieved by conventional cooling techniques. When the rate of air flow was doubled (60 ft./min./100 ft./min.), tube temperature was now reduced to 37C, Collins tests indicate.

The new dotted tube socket and associated forced air cooling technique appear to promise that Collins already is using them as a number of new equipment under design. One of its



TUBE socket data (above) permit direct forced air cooling of tube envelope

integrated communications system identification (CNI) package being developed for McDonnell Aircraft Co.

Tailored Air Flow

Different amounts of air are required to cool different tubes within an equipment and no air flow rates would be tailored to an individual tube's needs. To avoid the necessity of using a number of different tube sockets, each with different size slots, Collins controls the flow by means of the size and/or shape of channel cutout into which the socket is inserted. Seven standard cutout patterns, thus, for 7-pin tube sockets and four for 9-pin sockets, provide varying degrees of clearance for the air flow slots in the socket.

Collins' Robert E. Horn 30 Program points out that an attempt is made to seal the socket to the chassis to prevent air leakage. However, the main channel which serves as a plenum supply duct does need to be moderately well sealed. Collins uses liquid nitrogen for this purpose. The main tubes that are on the chassis are the less critical; the leakage problem becomes acute if it represents a smaller percentage of the total exhaust area, Program points out.

Collins has developed a few simple charts which enable an engine equipment designer to establish quickly the



- OUTPUT UP TO 5 VOLTS WITHOUT AMPLIFICATION
- ACCURATE UNDER 100 TO 1,000 CPS VIBRATION
- AVAILABLE IN VARIOUS RANGES FROM -500° to $+1000^{\circ}$ F.
- RESISTANCE CHANGE OF 100 OHMS OVER SPECIFIED RANGE

Trans-Sonics Type 1300 Bulb Temperature Pick-ups are precision high-speed resistance thermometers with a platinum resistance winding on the sensing element. Each Type 1300 Bulb Temperature Pick-up is individually calibrated and supplied with its own calibration chart. The temperature interval over which the 100 ohm resistance change will occur may be as low as 100°F. These pick-ups are designed to withstand pressures up to 3,000 psi. When specified they can be furnished for installation in corrosive liquids or gases. Their leads can be exposed to temperatures up to 600°F and may be detached from the instrument proper for shimming or easy replacement. Write for Bulletin 1300 to Trans-Sonics, Inc., Dept. T.

*See Technical

SPECIFICATIONS

- CASE CONSTRUCTION: Stainless Steel
Accuracy: $\pm 0.5\%$ of full scale range
Precision: $\pm 0.2\%$ of full scale range
MAXIMUM CONTINUOUS CURRENT: 25 ma rms (intermittent over 1 second)
TIME CONSTANT: less than 0.5 seconds in agitated water
ENVIRONMENTAL OPERATING CONDITIONS:
Pressure: 3000 psi (at room temperature)
VIBRATION: 1" double amplitude, 2 to 20 cps ± 15 ; 20 to 1000 cps ± 15
SHOCK: 40g in any direction, per pulse (4.161 of MIL-STD-883C, D) (no additional shock)

For Transducers, See Trans-Sonics

Trans-Sonics, Inc.

P. O. BOX 102

LITTLETON, CO. 80120



40,000

35.000

30,000'

Safety considerations for new jet aircraft demand a stretchy oxygen system for passengers and crew in the event that cabin pressurization fails.

On the new commercial turboprops, which fly at 40,000 feet, the system must be able to supply pure oxygen to passengers and crew via individual demand regulators. On the turboprop airlines, flying at altitudes up to 31,000 feet, this system may use continuous flow regulators.

Powers-Central announces a new Series High-Altitude Oxygen System to satisfy requirements of the forthcoming highaltitude jet transport. Advantages include:

- Minimum protection for flights from 40,000 feet at any rate of descent.
- Provision for emergency visual and/or audio warning.
- Instant availability in each passenger and crew member when needed.
- Compact, self-storing flow mode for passenger use.
- Complete feasibility of arrangement and location of passenger masks and regulators in briefest individual cases of isolation.
- Full self-storing capability.
- Ready availability at all times for divergent requirements.

For full particulars on this advanced system and why it meets *your* machine needs most efficiently, contact FUSHER CENTRAL DIVISION, FUSHER TRACTOR CORPORATION, DAKINPORT, IOWA. Ask for publication No. 55-185.

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torred air source requirements, estimate pressure drop and determine what max. clean inlet cut-outs should be used to match individual tube air flow to its cooling needs.

The air flow required to cool each tube below a predetermined temperature, say 100°C, depends upon a number of factors. Some, like power dissipation, can be determined in advance of building the prototype. Others, like heat radiated from nearby components, can not.

Collins says it can obtain a good approximation by basing on flow on a tube's power dissipation, its diameter (Tina & Reed) and length.

The techniques and charts which Collins has developed are described in the company's report No. CTR-179. A limited number of copies are available.

Requests should be directed to Call
any Radio Co., Technical Publications
Dept. Circle 100, 10



► **Any Courts-claim?**—Tenn. Instruments Inc. believes that it is the world's largest manufacturer of instruments, measured in numbers or in dollar volume, according to its president, J. E. Johnson. Company officials say that the industry will have produced 12.5 million instruments in 1996, valued at \$34 million. By 1998 production is expected to reach 17.5 million units worth \$50 million and by 1999 the figure should go up to 400 million units and \$225 million, according to TII. These figures do not include clocks and watches.

• **Inertial Guidance** — White-Rodgers Electric Co. has completed development of an inertial guidance system for short-range missiles. Bench testing currently is under way.

Tektronix Chelmsford-Semi-conductor's professional tester which can check out a 177-channel EMTM module while delivering output as low than one hour, automatically printing out its measurement in digital form, has been developed by Pacific Division, Bendix Automation Corp. The tester, which has provisions for self-pulsation, can produce carrier frequency and power output and frequency and amplitude of sub-carriers channel with respect to pre-determined input signals. Voltage and frequency measurements are converted into digital form. They would be trans-

► **Valuable Additions**—Remarkably complete and comprehensive treatment of the physics technology and current applications of transistors, diodes and MOSFETs is available in the book's text.

Pioneers in Electronic Research

Electronic research at the Jet Propulsion Laboratory covers many areas of interest to engineers working on problems of missile guidance and control. One of these is frequency and time standards—a prime requisite in Missile System Engineering.

The familiar crystal oscillator and similar timing sources have been replaced by the limits of their applicability. Looking to the future, our Electronics Research group is keeping abreast of developments in atomic and molecular resonance devices.

One such device under advanced development at the Laboratory is known as MASER (Micro Wave Amplification by Stimulated Emission of Radiation) invented by Prof. C. H. Townes of Caluturpie University. In MASER a beam of energetic molecules is

separated into energetic and non-energetic parts by an electrostatic field. The energetic molecules then enter a microcavity easily and sustain an oscillation by giving up their energy to the microwave field. The frequency of oscillation is determined principally by those properties of the molecules which are independent of environment.

MAER is one of the most stable sources of modulations and is therefore a prime source reference for frequency and timing information. This device will have many applications in future missile datums and is one of many challenging research projects in electronics in which the Laboratory is engaged.

If you are interested in an exceptional research opportunity and are qualified to do this kind of work in this area, write to today.

The *1st Fragilaria Laboratory* is a small research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80-acre area and employing 1000 people, it is close to extensive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in direct accord under contract with the U.S. Government.

Opportunities open to graduates
and engineers of U.S. citizens
and Canadians are listed.



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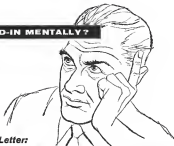
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BOXED-IN MENTALLY?



An Open Letter:

TO ENGINEERS, SCIENTISTS AND MATHEMATICIANS

Who Are Thinking of the Future

Whatever Your Past Experience... There's a Place for You in Atomic Energy at B&W

Take stock of yourself... your job... your living conditions. If you've boxed-in mentally, if your future looks dim, if you're living somewhere west of nowhere, or in a crowded city—or an outlying suburb—now is your chance to get out and better yourself. Go to atomic energy. Reply to an interesting job and live in Lisle—right in the heart of Virginia's Blue Ridge country.

There's plenty of elbow room right now in atomic energy at B&W. There's plenty of room to grow, in so many of our areas have flourished. This is the place and the time to consider. It—like most areas with your education and background—your thinking about your future.

HERE IS A NEW PROMISE—for you at B&W. And you don't need specific nuclear experience to take advantage of the opportunities. If you have training or experience in any of the following fields, there's a job waiting for you at B&W in which you can creatively apply your talent.

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Atomic energy is in its infancy. The opportunities for personal and professional recognition are great. You can be some part of the group of engineers, scientists, and mathematicians who truly are writing the rules, paving the way for those who come after you in this great field. It's like being at Kitty Hawk with the Wright Brothers. You're on the ground floor with B&W and you can grow with the field.

TODAY is the day to take that step toward building your future. If you face new and different problems, we have the job for you. The Babcock & Wilcox Company, Atomic Energy Division, 351 East 42nd Street, New York 17, N. Y.



Light Walkie-Talkie

Lightweight mobile HF walkie-talkie operates in the 2.4 to 4.6 mc. band, range 5 to 15 mi. including antennas and batteries, gets out 500 watts on 100 watts. Set can operate for 15 hr. continuously on a 100-watt battery. The antenna transmits, 35 minutes receiving. Two rechargeable batteries. Emergency operation will operate for 150 hr. on one battery charge. New unit, called Avionics Mark I, was developed by Aero Manufacturing Corp.

hired "Handbook of Semiconductor Electronics." The handbook is the work of 12 contributors, from a number of different companies, edited by David P. Harker of International Business Machines Corp. Current design sections cover low frequency, high frequency and video amplifiers. Sections on physics and analysis of semiconductor materials and various methods of device analysis are included. Extensive list of outside references follows each of handbook's 20 sections. (McGraw-Hill Book Co., Inc. \$12.00)

► **Automatic Flight Control Report—Radio Technical Conference for Automatic Special Character 15** has its latest report on the status of the use of automatic flight control techniques for air traffic control, approach, landing and taking. Report includes analysis of the first approach problem with criteria for adjustment of U.S. localizer facilities. Standards for localizer to cover output and autopilot response input characteristics also are recommended. Copy of the report, identified

there's a heat barrier on the ground, too!



With so much talk about the various in-flight "barriers," it should be mentioned, there is a "heat barrier" problem for jet aircraft on the ground, too. Ground chocking of instrumentation and other parameters require efficient and dependable cooling. That's why avionics for the Douglas Aircraft Co. use American Electronics' MA-3 ground support air conditioner on the F4D-3 SKYRAID and other aircraft.

The unit shown here has a "design load" output rating of 100 ft./min. of 450 air against 0 to 3 ppg static pressure with considerable output temperatures ranging between 55°F and 61°F. The unit is designed to perform under all world-wide operational conditions including ambient temperatures ranging from —65°F to 137°F. American's MA-3 is gasoline engine powered, but is also available with electric motor drives and is but one of a series of designs and capacities available. Construction and maintenance are such that satisfactory operation and maintenance may be obtained with relatively unskilled personnel.

If you have aircraft ground support cooling or heating problems, why not consult with American Electronics Engineers? They can provide an economical solution.



Whitney Building
111 W. Robinson Road
Los Angeles 11, California

Other products manufactured by the Division include: A-1 Precision Ground Support Equipment, A-2 Precision Ground Support Equipment, A-3 Precision Ground Support Equipment, and A-4 Precision Ground Support Equipment.



What do these documents mean to you? They mean a lot to you if you're an engineer, scientist, or mathematician. They mean a lot to you if you're a professional engineer, scientist, or mathematician. They mean a lot to you if you're a professional engineer, scientist, or mathematician.

as Fayer ISI-66/DO-74, can be substituted for \$8.99 by ordering RTCA Semiconductor, Bldg. F-5, Room 2078, Westborough 35, D.C.

- **Reduction For 1977**—Avionic industry forecasts for 1977 should be up 10% over 1976, according to practitioners in efforts of two major suppliers.
- **Microelectronics**—Stephen F. Kierling, vice president, predicts that automotive controls and instrumentation for aircraft and missiles will reach \$1.5 billion in 1977, approximately \$100 million above 1976 and twice the figure of five years ago.
- **General Electric's Dr. George L. Hall**

is, general manager of the Defense Electronics Division, estimates that military electronics will hit \$4 billion, approximately 10% over the figure for 1976. He also predicts that this figure will double in the next ten years even with a relatively stable defense budget.

(Some observers place the current military electronics expenditures in the \$4 billion bracket. Exact figures are difficult to obtain because the cost of much military equipment is now included in airframe/vehicle procurement figures.)

- **Adrian Te-Tai Ssu**—Collins Radio is building approximately 10-watt solid

state AN/ARG-58 transmitters, some of which will be tested by domestic and international forces this year or early in 1978.

Set is being developed under USAF sponsorship.

• **Boeing For The Hunter**—Boeing also is the scope of Sperry Gyroscope Corp.'s program to develop the basic-weaponization system for the B-1B. Hunter can be used from the fact that four of Sperry's major contracts show more than 300 options working on the program.

• **New Business**—Recent announcements of new contracts by various companies include:

- **Microelectronics**—General Electric received \$4.4 million contract from Air Force for automotive flight control systems for North American F-108F, two-place trainer version of the F-100 Super Sabre.

- **W. B. Mason Corp.** reports \$2 million Navy Bureau of Aeronautics order for airborne electronic navigation equipment.

- **Buena and Mac, Inc.**, New York, non-safety engineering firm, has secured "qualitative contract" to design and supervise construction of facilities to house electronic equipment for SAGE air defense system.

- **Electronic Equipment Engineering Co.** of Dallas has received \$70,000 contract from Bendix Radio Co. to provide 250 electronic distance radar control heads.



Super Memory

Twenty million bits of information can be stored in new Super Memory Datafile. 50 times the capacity of any other component now available, according to manufacturer. The new Datafile can be integrated into one computer system to provide 200 million bit data capacity. Datafile employs 50,150 four-wire superconducting wires under computer control at a rate of 5 ft./second. Two micro-wire leads are propelled continuously to meet pattern to insert or extract data bits. Computer reports indicate that 50 million bits will be passing them out at rate of 15 per month in 1977.

NEW AVIONIC PRODUCTS

Components & Devices

- **DC to DC Trans-Converters**, using semiconductor, is available in four models for inputs of 14 or 28 v.d.c. and outputs of 125 v.d.c. at 100 or 200 ma. Units come in hermetically sealed cans measuring approximately 3 1/2 x 3 1/2 in., can be operated in ambient temperatures of -35 to 75°C.



close. Unit comes in hermetically sealed, pinless case, measures approximately 1 1/2 x 1 1/2 x 1/2 in., weighs 6 oz. M. Tim Beck, Inc., Pleasantville, N. Y.



- **High Temperature Rheostat**, Type 338, for operation at temperatures of -65 to 121°C, is designed for 400 cps. use, with contacts rated for 2 ma. at 100 v. Phase angle has between 90 and 150 deg. lagging between -20°C and 100°C, and between 45 and 90 deg. from 100°C to 121°C. Drive coil is rated for 5.3 volts. Units are hermetically sealed. The Avion Products Co., Middle River, Baltimore, Md.

- **Schottky Transistor** for printed circuit applications, Model 205, has

with efficiencies up to 90%. Regulation is quoted at 20% on standard units, but is available to 0.5% if required. Special units also are available with different input, output voltages and ratings up to 500 watts. Power Sources, Inc., 4 Schuler Court, Irvington, Mass.

• **Metal-Film resistors**, fixed and for potentiometers, sealed in epoxy tube, with resistances of 1 or 10, rated 4 watt at 50°C or 125°C are now available in



resistances of 1,000 to 100,000 ohms with temperature coefficients of 25 or 50 ppm. Winters Electrical Industries Corp., Newark 32, N. J.

- **Transistorized wave amplifier**, Model 5000/0300, for 60 cps. use, is designed to drive a 5-watt sine-wave (Sears) Type R 160-5 or equivalent. Amplifier draws 350 ma. at 28 v.d.c. for maximum output signal, 20 ma. for average signal. Voltage gain is 190 at 2 cents output, input impedance is 10,000

MODEL COSTS CUT IN HALF!



Models now cost less than most home made templates. Now you can get a new type of layout model containing only essential detail (no "fingerboard") and costing half as much as heavily detailed models. Now cost is 29¢/sq. ft. of plot depending on congestion and size. These simplified models are available in various scales: 1/4, 3/16, 1/8, 1/16 to the foot.

A team of engineers & craftsmen



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0.025 to .010 pin terminals for mounting and connecting. Provision also is made for both mounting screws. Unit is rated 4 watt at 50C, can operate up to 100C. 7-4 provides 25-ray screw driver adjustment. Burns Laboratories, Inc., 6115 Magadia Ave., Riverside, Calif.

• Mesitane crystal fiber, with 28 mc. center frequency and 50 mc. bandwidth at 6 db. attenuation, occupies only 4 cm. in volume and weighs 1 oz. Shape factor (base of bandwidth) of 30



db to 6 db.) is 41, aperture loss is 1 db maximum. Technical bulletin describing this and other filters in the 40 to 160 mc. range are available. Photon Electronics, Inc., 75 Cambridge Parkway, Cambridge 42, Mass.

• Subminiature relays, in DPDT contact arrangement, are available in two types: S-111, with 25 amp. per pole sensitivity, measures 2 in. dia x 1 1/2 in. Type SM-110 has sensitivity of 30 mc., measures 1 in. dia x 1 in. long. From one switching 1000 times, operate over temperature range of -65 to 125C. Non-gaseous silicone materials are used throughout. U. S. Relay Corp., 1744 Albion St., Los Angeles, Calif.

Laboratory Equipment

• Transistated pulse generator, Model 502, operates from self-contained 22.5 v. battery which provides useful life of 450 hr. Device provides pulse length from 4 to 3 microseconds in three steps with a 20 volt peak into an 800 ohm load. Positive or negative pulses are continuously variable in amplitude from zero. Rise and decay time is 0.1 micro-

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second or less, with less than 25-100 and evenbush. Repetition rate from nominal synchronous is 10 to 5,000 cps, or 1 to 5,000 from external synchronous. Device weighs 4 1/2 lb., is priced at \$325 including battery. Cubic Corp., 1975 Kearny Villa Road, San Diego 12, Calif.

Computers & Datamation

• Electric typewriter for use as input/output device with computers, operates at speeds of 120 words minute. Unit, apparently same size as standard office electric typewriter, is available with carriage lengths up to 33 in., and is priced from \$740. International Business Machines Corp., Electric Typewriter Div., 290 Madison Ave., New York 22, N. Y.

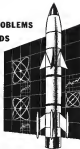
• Pulse-to-analog converter, Model 895 "Retrostep," is an electro-mechanical shaft positioning device which provides controlled incremental shaft rotation at one two-degree step per d.c. pulse. Rotation is unlimited in either a CW or CCW direction and stepping speed is as high as 60 steps per second, with longer output up to 14 in. Between pulses,



shaft position is accurately locked. Input is 1 step at 25 d.c. with pulse duration as short as 10 milliseconds. Optical control system provides homing to a fixed reference position, automatic continuous stepping with speeds d.c. up to 100 rpm, and/or potentiometer output proportional to shaft position. G. M. Glavin & Co., Inc., 215 East Green St., Pasadena 1, Calif.

WHICH OF THESE PROBLEMS FIT YOUR FIELDS OF INTEREST IN

INERTIAL GUIDANCE



BELL has recently scored an important break through of one of the major technological barriers in the field of inertial instrumentation... a break through of such importance that no expert on inertial techniques of the future can hardly be overestimated. This has resulted in one of the most far reaching and most promising inertial navigation programs that exist today. Here are some of the pertinent problems in the field of precision inertial instrumentation on which Bell engineers are now working.

1. Develop an AC amplifier with a gainability of 1 part in 20,000 over a temperature range from 30° F to 140° F, a frequency response from 200 to 200 cps, a weight of less than 5 pounds, and capable of withstanding up to 10 g's vibration.
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4. Develop a resolver system for DC or AC with an accuracy of 1 part in 30,000 that uses standard electronic and mechanical components and weighs less than 2 pounds.

If your qualifications place you in a position to help solve these challenging problems... or if you are now limited in the scope of your opportunity and would like to participate in any of Bell's widely diversified activities in other fields, write today: Manager, Engineering Personnel, Department E-1, BELL AIRCRAFT CORPORATION, P. O. Box 604, Buffalo 6, N. Y.

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SEEWATCH for smoking plume is kept from operators but (foreground) is a swamper Nord Aircraft Parkey NIN looks up for another trip over forest fire.



BORATE POWDER is emptied from 50-lb. bags and is mixed with water in heavy combination.

LOADED STEARMAN (below, right) waits for NIN to clear the landing area.



BUSINESS FLYING

Fire Fighting Planes Tested

Aircraft may play an important role in fighting future forest fires as a result of successful experiments conducted by the U. S. Forestry Service in California. These trials have also furnished valuable information on operating aircraft equipment and tactics for these missions.

California's Forestry Service personnel estimate that the use of several aircraft would provide savings of more than \$500,000 in one year, their indicated effectiveness being that much in loader, cost of replacing, extra fire crews and special equipment. It is calculated that the planes would be used a minimum of 400 hr. annually with operational expense being approximately 590 hr.

An evaluation program is now under study by the Forest Service Special Equipment Center at Arcadia, Calif., which is practicing operational techniques at various fires and tests.

Shoreline Fire

Both state and federal departments of the Forestry Service used aircraft to a limited extent in 1955. The technique evolved from a fire broke out in the Shasta National Forest near Greenville in the 3,100-ft. level. Since neither fire crews would require aerial help to get in the zone, it was decided to try aircraft.

In the time the five Stearman were loaded and on their way, the fire had spreaded to an area of approximately 170 acres, yet the airplanes compensated it with some 60 drops before the fire trees could get to the zone.

The experiment was a few factors in the decision to let contracts to aircraft operators for fire control work in 1956. Actually, the response was low, because many agricultural plane operators felt that the modifications necessary would restrict the numerous jobs of their planes.

William Flying Service, Willow, Calif., a seed and dust firm, took the opportunity because the forestland paid well during its slack season. In operations during fires in the San Bernardino Mountains, where rugged slopes of 35% or more were met, aerial application turned out to be the only way of reaching the blazes.

The crop during planes and pilots need power to be easily adaptable to their mission.

In most cases to date, water only has been dropped from the aircraft, where fires threaten large areas, a chemical

substance of borate and water has been dropped.

Four pounds of borate, a sodium-borate powder made by Pacific Borate Co., is mixed with sufficient water to make a gallon of solution, weighing about 12 pounds.

Although more effective than water because its evaporation rate is much less, the borate solution sticks to soil and plants, making replanting unnecessary and saving the way to soil breakdown in hillsides.

The water or chemical is dropped in four to six seconds. Spray borate can not be used. In the case of water, the discharge would be too fast permitting rapid evaporation; the chemical solution is too thick to be pumped through hoses in hoses.

Maximum Load

The Stearmans actually used standard aircraft dump valves. These were changed to a full throat bigger dump valve, with most planes having a maximum 175-lb. capacity (three full bagging trip loads).

Loading throats were enlarged to five or six-inch diameters.

The 150-hp. Stearman can take a maximum load with safety factor of 115:121 gal. of chemical or water, thus drops from approximately 10 ft. altitude. The chemical generally disperses to a width of approximately 125 ft.

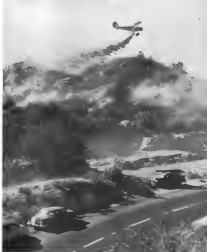
Drops are made on the fringes of a fire by one or more aircraft flying single or grouped in a staggered formation, guided by a director plane.

As a result of actual experience with aircraft, these requirements for future operations are indicated:

• **Radio equipment** is a must, none of the Stearmans were so fitted and the use of a director plane proved to be inefficient leading to confusion. Radio would allow the chemical or water dropping pilot to stay in contact with fire command for greater efficiency and also with the script.

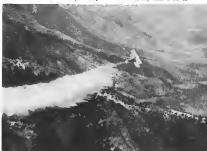
• **Loading and dumping** of material must be simplified to speed up approximately the dump rate should be convertible to allow second passes. The current forward dumping opening must be closed after it is opened in flight until after landing.

• **Aircraft** should be fitted with rules for dropping fire equipment to ground crews as it is better to have some ground rules than no ground rules at all.



CHEMICAL SWATH is changed by low flying script NIN trailer. Flare at spot where are hit by individual planes, formation drops are made on major areas or along a fire front.

STEARMAN PULLS AWAY after quick dump of its load. Swift way water is 125 ft.





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Flight Tests Begin For Austrian O.K. 15

Vienna, Austria—Actual flight tests have started on the first Austrian design airplane since 1918. Prototype O.K. 15, a low-wing two-seat side-by-side lightplane is designed for utility and touring.

Powered by an aircooled four-cylinder Walter Minor III engine, of 105 hp, the O.K. 15 has a top speed of 136 mph and cruises at 124 mph.

Range of the new aircraft is approx 400 mi.

Mixed construction, comprising metal, wood and fabric is used. Designer is Otto Karch and the airplane was built by Austrian Henschel Werke, Ltd., Wiener Neustadt.

Following tests by the government, the O.K. 15 is scheduled to be put into production.

New Training Course for Agricultural Pilots

Course to train commercial pilots in actual application of agricultural materials has been drafted by several California aviation and educational organizations.

One of the objectives is to relieve what these organizations call a critical shortage of trained spray pilot operators in the state.

Formed after Texas A & M College System's course (AW) Apr. 16, 1946, a 971, the training is being offered by University of California, Davis.

Flight instruction of approximately 30 hr. will be provided in Stinson and Piper PA 15A aircraft. Experienced agricultural pilots can take an abbreviated 15 hr. flight course if they desire check-outs.

Classroom instruction in the handling of aerial application chemicals is included in the curriculum.

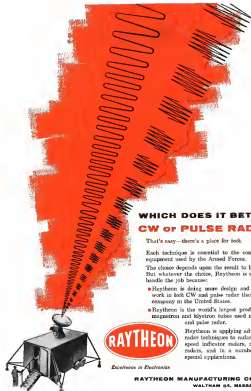
Oakland Airport Plans New Hangar Construction

Building of 34 hangars and general plans, totaling costing more than \$200,000 at Oakland Metropolitan Airport has been approved by the Board of Port Commissioners.

Construction bids will be opened Jan. 31.

Type of hangars will depend upon cost, both T-shaped and closed-bay types are approved. Plans call for building 25 units in hangar single-engine aircraft, the remainder for twin-engine types.

The airport now has sufficient room for construction of 100 small hangars, the Port of Oakland states.



WHICH DOES IT BETTER - CW or PULSE RADAR?

That's easy—there's a place for both.

Each technique is essential to the complex radar equipment used by the Armed Forces.

The choice depends upon the result to be achieved. But whatever the choice, Raytheon is equipped to handle the job because:

- Raytheon is doing more design and production work in both CW and pulse radar than any other company in the United States.
- Raytheon is the world's largest producer of the magnetron and klystron tubes used in both CW and pulse radar.

Raytheon is applying advanced CW radar techniques to radar altimeters, speed indicator radars, navigational radars, and is a number of other special applications.



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THE ERA OF THE ELAND IS BEGINNING...

The case for ELAND conversion

To forward-looking operators of turbine-haul airlines the case for ELAND conversion becomes clearer and more convincing month by month. Increasingly they see that ELANDS point the way to the achievement of better performance, greater carrying capacity, and greater dependability in service from well-proven aircraft.

No beat, white or whistle

ELANDS possess in the field that inherent asset of the turbo-prop—a greatly reduced noise level. And over and above that they have an inherent asset of their own—a complete absence of beat, white or whistle. The passenger appeal implicit in this needs no emphasis.

Flexibility of power

ELAND design provides a wide range of power in a one-sized package. The 3,000-4,000 h.p. range of ELAND engines differ nothing in size and only little in overall weight. This flexibility will enable operators to standardize on one basic engine and nacelle design where two or three different types of piston engines are now required.

Conversion of the Conair 340

The Napier Eland Conair—a Conair 340 which we bought from the makers and converted to ELANDS—has proved the simplicity of ELAND installation, the low cost of conversion and the increased profits that accrue from ELAND operation.

From studies made of the published direct operating costs (including depreciation) of a number of typical airlines, it is proved that in the light of our guarantee a converted aircraft will be cheaper to operate—whether the costs are calculated on the basis of aircraft miles, ton miles or passenger miles. The piston-engined Conair 340 can carry its maximum payload 950 miles further than piston-engined Conairs, and its cruising speed is 30 m.p.h. higher.

In short, we offer to operators of the Conair—and other medium haul "planes-as-aircraft with a new lease of life as a jet which will be viable off even a relatively short period. That is the source of the case for ELAND conversion.

Eland conversion means increased profits to the progressive airline

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100, Cannon Street, London, W.C.2, England. Tel. 01-403 1100.



Three examples of converted Napier Eland aircraft—the Conair 340, the Eliphelet, the Pencil.



BIGGEST MOVE in Pacific Airmotive's expansion and strengthening program was purchase of former Los Angeles Engineering Division. Pacific Airmotive gained this facility where Eland conversion is underway, and 32 experienced engineers.

Pacific Airmotive Aims at Expansion

By Terese Lang

Turbine, Cold—Again: Another in engineering talent keynotes Pacific Airmotive Corp.'s program to enlarge and strengthen its West Coast aircraft modification and service facilities.

PAC made its biggest move when it recently picked up Los Angeles Engineering Division, Santa Monica. Re-named Pacific Airmotive Corp., the new subsidiary added 32 engineers to Pacific Airmotive's roster, with equal ease ranging from the latest five engine engine through through multi-engine turbine planes, jets and helicopters, missiles and test vehicles, including air buses, control systems and advanced types of propulsion.

Wing Competition

The former owner, equipment manufacturer, Lear, Inc., felt that the division had grown to where it was competing with Lear's customer's. The Santa Monica facility is housed in a \$12,000 facility capable of handling Super Constellation and DC-7s.

It is a facility which has demonstrated an ongoing capacity in the "Eland," Pacific Airmotive president John Myers told AVIATION WEEK. Much of Pacific's development work and proving out of complex equipment



AIR FORCE C-119 delivers a Pratt & Whitney JT7 engine to Pacific Airmotive for modification and overhaul. Pacific Airmotive had handled more than 700 JT7s.

installations has potential application to military aircraft.

Pacific will continue to explore the Eland's economic transport market, in addition to studying wider modernization programs for other types such as the DC-7 and Constellation. Also in the works is adaptation of the Conair 340

to Napier Eland turbo-prop-Paciers and that the modification will increase the transport's cruising speed by 55 mph. It was that it is taking in one order about such a conversion.

The parent company estimates that it will gross over \$20 million in the current fiscal year. It expects that the

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This maintenance-free position lock for reclining seats is entirely mechanical...has no fluid or oil passages or electrical leads to lubrication or service during its life. The lightweight Pacific Seat Lock is now automatically self-adjusted for any seat frame or recline life. Provides smooth, safe operation, and needs no further attention after installation.

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(10) Please send me information regarding SEAT LOCK

new Pacific Division will bring in \$4 million next year in sales of the Los Angeles area.

Pacific America's tramp card is diversification. It breaks its operations down into three line classifications:

- Airframe overhaul of commercial, executive and private aircraft, which accounted for \$1.7 million of its 1976 business.
- Engine, propeller and accessories overhaul, \$4.2 million.
- Military airframe overhaul, accounting for \$5.1 million this year.
- Products sales, including distribution of aircraft and engine parts, which totaled \$0.7 million in 1976.
- Manufacture of test and ground support equipment, \$3 million.

Pacific America is planning expansion of its business aircraft overhaul plant and is negotiating with Lockheed for additional shops, also available on 61 acres at Ontario (Calif.) Municipal Airport.

Workload Rise

Its Barberic engine and products division has increased its workload 1976 over 1975 through signing long-term contracts with 11 airlines. It is looking for test expansion at its executive aircraft engine and equipment business segments.

A major feature of the engine overhaul operation is its expansion with jet engines and accessories. It has considerable experience in jet engine modification, including the P&W T74 turbofan, Westinghouse J40 and P&W J57 turbojets. It has worked on over 100 of the latter.

Myles told AVIATION WEEK that the company has started discussing retool and modification contracts with several airlines and is particularly interested in those carriers who will be operating fleets later in 1977 transports. He expects that PAC will be in a position to offer airline modification savings in overhaul by using its facilities instead of building their own.

Shop Ready

The fact that PAC already has a shop working on J57s should place the company in a favorable position when discussing overhaul with airlines, it feels. At Barber AFB, where personnel were told by the Air Force that an airline would have to spend \$4,700,000 to build and equip an engine shop (AW Oct. 29 p. 32) PAC points out that the J57 fuel control test stand alone costs between \$40,000-\$50,000. In 1977 the company plans to put in a jet engine test cell and additional facilities, plus equipment to test J57 fuel control systems.

Myles says that it is difficult to give a fair price figure on a working test J57 of this type, because the engines

ENGINEERS

Membership in Engineers

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The Applied Physics Laboratory, (APL) of the Johns Hopkins University is an organization of and for technical men and scientists. APL is organized on a horizontal basis, responsibility and authority are given in equal measure. Scientists and technical men occupy all decision-making positions, because our only spectrum is technical progress.

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Doublet socket loading daily for Douglas made in England at Foster Aerospace

processed then for by the company have varied in the type of work required and that no one operator has had a typical "rotated" schedule. He did say, however, that PAC expects that it will be able to overhaul 35% of its considerably less than figure quoted by the Air Force.

Manpower training is another important consideration. Myers says that it takes 100 hr to train personnel to operate a jet engine that cannot test stand properly and 350 hr for a hot bench operator to learn to calibrate a jet engine test control. The company has been calibrating these systems for approximately a year and a half.

Last summer, Foster Aerospace received its first agreement with United Oil Company of California. Site of 110,000 drums of Union Oil's PAC stock to key PAC officers and managers must personnel give the group the highest kind of stock interest, with Union Oil still retaining a substantial portion.

Reward loss agreement provides for a 30-yr 4% ownership stake of 54,100,000 shares (previously provided in quarterly installments starting Dec. 1, 1974). The arrangement amounts to a \$440,000 reduction in PAC's long-term debt.

Aero Design Building New Commander Plant

Construction is underway on a new \$1.5 million 120,000 sq ft plant for expanded Aero Commander business plane production. Aero Design & Equip. Group Corp. expects the 14-acre site to be operating Aug. 1, 1977.

The new production potential will be about double the present site. According to the company, the new facility will permit output of as many Aero Commanders as one year it have been produced to date.

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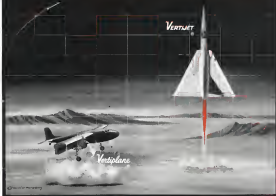
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EQUIPMENT

Airlines Invest \$50 Million in Idlewild

By George L. Christen

New York—Three major U. S. air lines Pan American World Airways, Trans World Airlines and American Airlines, are investing over \$40 million in hangar and office construction at New York International Airport.

Two other large carriers United Air Lines and Eastern Air Lines have occupied new hangars which cost together over \$10 million, bringing the investment of just completed, under construction, or planned offices, hangar facilities at Idlewild close to the \$50 million mark.

PAA's and TWA's hangars are under construction. American's will probably start work this year.

PanAm's Plan

Pan American and TWA plan large facilities in which they will consolidate Atlantic Coast activities under one roof.

TWA will group its Atlantic Region offices at Idlewild, but will retain its L-Guarder maintenance hangar for planes using that airport. American, United and Eastern will use their Idlewild facilities as additions to their existing New York area hangars and offices.

The American plans to consolidate its entire Atlantic Division in the 510,000 sq. ft. hangar building going up at Idlewild. The hotel will be all departments making up the organization, such as operations, traffic and sales, training and purchasing, personnel, mail and personnel.

These offices are now scattered at three different Idlewild locations and at LaGuardia.

Cable Continues

Also included will be DeLaval towers to check flight times and on Pan American's latest aircraft, overhead and maintenance facilities capable of handling any type of aircraft have been added to heavy service terminal building overhead, and the addition of street engine and airplane accessories.

Engine overhaul now performed at Miami is not contemplated for the Idlewild hangar.

Planes and TWA's hangars use of identical design although different in size due to American's and Western's structural capacities.

Concept of cable suspended construction construction was in fact already made to support heavy use.



TWA will group its Atlantic Region offices in this \$15 million building at Idlewild.



PAN AMERICAN will consolidate its Atlantic Division in a \$14 million facility.



UNITED moved into the hangar 15 months ago, later half of it to American.



EASTERN also moves half its year-old facility in this new to Seaboard & Western.



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crete tiled plate or "concrete-tile" roof.

The design eliminates the need of posts or pillars to support the roof, giving a completely clear, unobstructed hangar floor.

The buildings consist of a long, main center section on each side of which the hangar bays extend, supported by a system of steel cables whose opposite ends are secured to anchorage walls at speed at 10 ft intervals along the top of the hangar bay sections.

First Use

Armstrong & Whitney developed this new type of hangar construction in cooperation with TWA. The first hangar built to the design is now about 35% complete at TWA's new Kansas City, Mo., hub.

The outer edge of the wide roof (130 ft on each side in PAA's case) will have an up-and-down deflection of 12 1/2 ft in due to load and wind during erection and construction, snow loads, and other factors. To accommodate this considerable movement, the hangar doors have a 10 ft top section whose lower edge is hinged to the top of the door and whose upper edge rides on tracks underneath the hangar roof.

Ceiling height ranges from 45 ft at the door to 35 ft at the inner end. For Air's hangar, which is 640 ft long, will accommodate five DC-7C or four 707 or DC-8 jets per side. Provisions have been made to expand this hangar capacity to about 75% if required.

Within the 300-ft-wide, three-story engine section will be a training school, complete commissary and a light load service kitchen, warehouses and shops, and maintenance and overhaul shops and offices.

Two Wings

In addition, there will be two wings. The west wing, measuring 315x100 ft and the East wing 200x101 ft, will house additional offices.

The larger will be indirect heated, the offices occupant an underground parking lot. The smaller, which will be heated to cut down noise and dirt, are to be built that a second set may be easily added to meet jet engine noise should the price to be a problem near the jet helicopter-processed aircraft go into operation.

Additional facilities include hangar on which component overhaul shops can be built; a shop area capable of accommodating 12 jet engines, aircraft and a parking lot with an initial capacity of 500 cars.

Both PAA's and TWA's hangars have the heating and air conditioning plants in enclosed structures on the roof of the engine section rather than on the ground floor where floor space

is not valuable. Fuel oil is pumped up to the hangar.

It will be an ideal location for a Trans World Airlines' overhaul base, being the location for its own domestic flights and the Western terminus of its international network.

TWA's New Base

The \$15-million facility will be used primarily for line maintenance of TWA's International fleet and much of its fleet engine overhaul fleet. Engine overhaul and heavy maintenance will be centered in the other's new overhaul and maintenance base in Kansas City, Mo.

The TWA hangar is unheated larger than Pan Am's, being 814 ft long and 460 ft wide, with an 80 ft wide center section. The cable system, parallel cables, each on each side are 150 ft wide to which is added 10 ft per side for the hinged doors. Height at the door is 45 ft.

The hangar can accommodate 12 planes the size of 1049 Constellation (no 740s or 747s) or 10 1649 Constellation or jets—live to a side.

The center section will house such facilities as storage, maintenance shops, and aircraft offices.

While TWA plans to move all its LaGuardia regional offices to the new

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Preloading Aids Cargo Operations

Preloading, unloading and palletizing are the three keys to streamlining air cargo operations to obtain maximum aircraft ground time, and satisfactory cargo handling—lower costs, achieve highest plane utilization and increase revenue.

These operations were explained in a paper given by C. W. Midkiss at a meeting of the American Society of Mechanical Engineers held recently at New York. His talk was concerned primarily with all-cargo operations, which now account for about 40% of total tonnage of the combination passenger/cargo aircraft.

Midkiss, who heads his own air cargo consulting company, made these points:

- **Preloading** cargo allows it to be assembled on pallets or other types of containers and loaded as soon as the aircraft is ready to accept its freight.
- **Unloading** a load allows a dispatcher to handle the cargo in the most efficient manner. By using a device called a shockable dolly box, cargo need be handled only twice during the loading operation—once from truck to container, and again from container to box. This will also help to keep leakage at a minimum.
- **Palletizing**, while now a partial two-step for cargo aircraft loading and unloading, should be replaced by such Air Line, Midkiss advocates.

An American Airlines representative cited this dynamic saving which palletizing accomplished under certain operating conditions:

South Air Freight Express, Ltd., used these British Freighters to shuttle cargo across the 50-mile wide Gulf of South between New Zealand's North and South Islands. It was in a full armed version called Cargus, the cargo plane produced their 12,000 lb. payload 2,000 lb., but Cargus stalled in one crash, being able to do the work at three, bringing about large equipment and maintenance savings. The Cargus extra allows a 10,000 lb. cargo to be loaded in about 17 minutes.

An objection was voiced against this use of palletizing as being too expensive for military use, where cargo aircraft carry 6, and the same rule holds. However, it was concluded that the method was probably fair for the two-terminal operations of RAFs.

Midkiss suggested the use of a new type of dynamic automated tractor for towing trailers to predetermined locations. The tractor would follow ways based under the floor or suspended overhead.

Such an installation which the U. S. Air Force has called Condemor, is

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going into operation at Kilo A/B Sea Island, Tex. The tractor follows a line painted on the floor with a special kind of paint. As a guide to what weight of cargo is sent in on Midkiss said these figures:

An average shipment weighs 711 lb. and the average piece weighs 30 lb. Above 91% of all cargo air cargo shipments weigh less than 100 lb. and 66% of all shipments weigh under 1,000 lb. Some 57% of tonnage shipped weighs between 100-500 lb., and 50% of the tonnage weighs between 100-1,000 lb. and 5% of total tonnage exceeds 5,000 lb.

Midkiss concluded his paper by suggesting that pack plans, such as the Palletized NC-120, might be successfully used as air freighters. Completely pre-loaded haulage could be taken to the correct plane for straighten-out and attached to aircraft.

OFF THE LINE



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New service tray, which can fold over the back of a seat, is independent of the back rest when in use. It provides a steady platform from which the passenger may eat or relax. He can use it to read or work. The tray is foldable so it can be stowed in a storage bin. It is made of a lightweight material and is incorporated in passenger seats in the C-119 and C-124 aircraft. Manufacturer: Herndon Tool & Engineering Co., 6347 South Beach Drive, Los Angeles 25, Calif.

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Henry Krieger (second from left), head of the Electronics and Armament Systems Division, discusses problems inherent in the application of large electronic sensing devices to aircraft with David Weverberg, AECW, Systems Specialist, World Wide, Data Link Specialist in the Aerospace Technology Group, and Nelson Morrison, head of the Electronics and Armament Systems Engineering Department.



Lockheed expands electronics division

■ To keep pace with its ever-increasing emphasis on electronics, Lockheed has expanded and reorganized research and development activities under the Electronics and Armament Systems Division. The Division is under the direction of Henry Krieger.

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closed fibrous glass units on the walls, ceiling and floor. Over include location of mechanical noise source, essential before study of noise, noise equipment determination of loudspeaker response and acoustic characteristics, precise free-field calibration of microphones and microphones and audio research.

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Zipper Cable Sensor

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• **Development of Heat Resistant Alloys in Powder Metallurgy Techniques** (PB 121585)—by G. Zermeno and others, Johnson Electric Products, Inc. for Wright Air Development Center, 52 75, 63 pp.
• **Second Experimental Truck Symposium** (PB 125406)—Summary Reports and Abstracts of Papers Presented and Abstracts of Papers Received, U. S. Air Force, 51 50, 51 pp.

• **Vacuum Evaporation of Heavy Metals**—in Films (PB 121173)—by W. R. Turner, Naval Ordnance Laboratory, 51 00, 14 pp.
• **A Fundamental Study of Natural and Synthetic Fibers as Magnets** and as Alloys (PB 121322)—David Chemical Company for Wright Air Development Center, 54 25, 16 pp.

• **Development of Fluoropolymer Elements**, Part 2 (PB 121794)—by R. E. Turner and G. W. Doyle, Fluoropolymer Chemicals, Inc. for Wright Air Development Center, 75 00, 24 pp.

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TIC was the originator of the high stability potentiometer trimmer pots. For example the original metal-film potentiometer, the TIC TIC Model, represents the outstanding advance high stability trimmer potentiometer design. The TIC Model contains a resistance element of metal film that provides infinite resolution for ultra-fine trimmer. Components of the TIC Model include 1 to 2 ohm to 100K ohm. Latest addition to the TIC Trimmer Line is the new low cost RPT which, like the RPT, provides adjustment by use of a 20-turn lead screw.

Complete information on the TIC Trimmer Potentiometer Line is available upon request.



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One of, Harsco & Co., Ltd. of, N. W.
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Industrial: One type (HFB-14) 75 cu.
14000.

*Fuchengling Industries Ltd. 1-1 Page 31.
 Guosheng N. J. (preprocessing) Singapore
 State Corp. Efficiency (see) working members
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 44474 (1986) 001 273 001, 0110204
 *Fuchengling Industries Ltd. 371 Page 31.
 HONGKONG N. J. (working) members 1985
 March 1986, type 1, 001 11, 001 11, 001 11

LIBRARY AIR FORCE REPAIR Gunders Air Force Station, Gunders, Ala.
Engine Mount Castings Case. Bulletin 11, N. Y. has engine mounting and attachment member design cylindrical design to make the engine with its longitudinal axis parallel to the base, spec. MIL-C-8344A dated 21 Jan 52 and manufacturing data 440 on 2071454. (AFM 31 60345-4001,2)

Midwesterners: These interesting companies (Gardner, Inc., box machine supplier and storage shed manufacturer) began recruiting for only the earlier 90s. In total, I listed nine new hires in the last year. MFLC (MFLC, dated 2/20/90) and (MFLC) dated 2/20/90 are (MFLC) dated 2/20/90.

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not stopping and always small com
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a variety of plastic characters with 2 100-1
handles: one in the middle for wires in
stayed pairs (smaller of each one 100-1)
is: 100-100-1 100-1 100-1 100-1-100-1
CUBA11 dated 10 PM 10 and 100-100-1
dated 10 (one 10, the one 100-1 100-100-1
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write to:
Mr. C. Nocol, Dept. A,
Box 225, Riverside, Calif.



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WHO'S WHERE

(Continued from page 23)

William D. Fowler, director of defense contracts, Watford-Singer Corp., St. Joseph, Mo.

Emmett H. Heller, sales department head, Instrumental Division, Electronic Filter Controls Co., Anaheim, Calif.

Richard M. Ogden, manager, Wireless Laboratory Systems, Thorpe Products, Inc., Waltham, Mass. Mr. Ogden succeeds Dr. D. G. Flinn who has joined Eastern Electric Manufacturing Co., St. Louis.

Gordon Williams, public relations manager, Transport Division, Boeing Airplane Co., Seattle, Wash.

W. H. Toy, general superintendent, Tugboat Air Products Corp., Loswood, Calif.

Edward B. Smith, director of operations, White Kolls & Co., Inc., Buffalo, N. Y.

Henry Blankenship, production and factory manager, Pacific Aircraft Corp., Philadelphia, Pa.

William A. Kemp, Washington, D. C. representative, All American Engineering Co., Wilmington, Del.

F. R. Henry, manager Illumination Department of General Electric Co. has been named 1957 chairman of the American Gas and Lighting Section of the National Electrical Manufacturers Assn.

A. V. Tancillo, manager European sales operations, Verbal Aircraft Corp., Morton, Pa.

Richard Leslie succeeds Mr. Tancillo as assistant sales manager.

Dr. Richard J. Baker, head jet-engineering department, Lockheed-Siemens Systems Division, Van Nuys, Calif.

Charles E. Ross, Jr., assistant to the president engineering, Gladden Products Co., Cleveland, Calif.

Paul E. Muehle, chief industrial engineer, Radiologic Division, North American Aviation, Inc., Downers Park, Ill.

Charles Christie, assistant manager—sales planning, Transport Division, Boeing Airplane Co., Seattle, Wash.

James R. Griffin, to handle special assignments for the president, Cleveland Pneumatic Tool Co., Cleveland, Ohio.

Lyons R. Bennett, a motor development engineer, Northrup Aircraft, Inc., Van Nuys, Calif.

Neal W. Donahoe, Washington, D. C. representative, Avco, Inc., Troy, Mich. Mr. V. Muncy J. Campbell, director—product sales, and John T. Bailey, quality manager, Weapons Systems Division, Bell Aircraft Corp., Buffalo, N. Y., also Successor A. Louis, purchasing manager, and Raymond C. Snow, quality manager, Bell Aircraft Division.

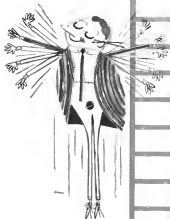
John W. Johnson, director—engineering, Chance Vought Aircraft, Inc., Dallas, Texas.

Dr. Charles E. R. Chitt, Jr., senior scientist, Research and Development Department, Boeing Airplane Manufacturing Corp., Everett, Wash. also Richard F. Hone, manager experimental, same building.

W. W. Richardson, defense products manager, American Mulkiss & Foundry Co., Los Angeles, Calif. Mr. Richardson succeeds Bennett W. Wright, mixed general manager of AJA's Turbo Division, Pomona.

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